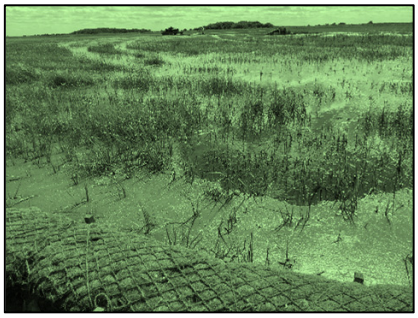
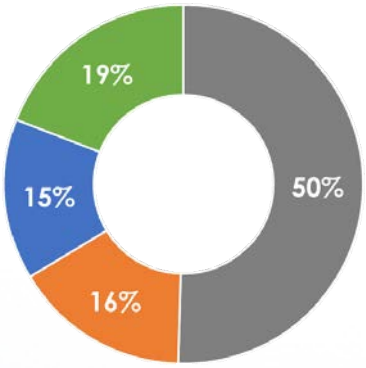
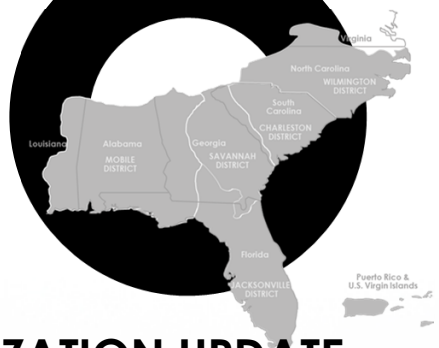




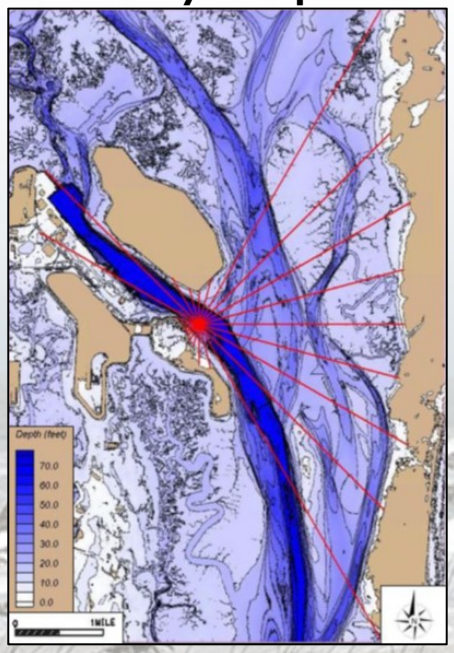

2020





REGIONAL SEDIMENT MANAGEMENT OPTIMIZATION UPDATE
South Atlantic Division, United States Army Corps of Engineers



U.S.ARMY

US Army Corps of Engineers

RSM RCX

COVER IMAGES

1. Estuarine/Riverine Placement. Thin Layer Placement at Jekyll Creek, Georgia.
2. Jekyll Creek Thin Layer Placement. Biodegradable coconut coir logs are stitched together to contain dredged material on the marsh.
3. Beach Placement. Beach compatible sediments dredged from Kings Bay, Georgia channel are placed on nearby Nassau County, Florida beaches.
4. Coastal Resilience. Regional Sediment Management (RSM) strategies and principles help address the need for increased coastal resiliency.
5. Beneficial Use of Dredged Material. Sediment dredged from the Jekyll Creek, Georgia channel is placed on Jekyll Island marshes as a proactive measure to support marsh resilience and in open water at the mouth of St. Simon's Sound to support RSM principles of keeping sediment in the system.
6. Nearshore Placement. Volusia County, Florida.
7. RSM strategies throughout the South Atlantic Division (SAD) by placement type. Green: estuarine and riverine placement; orange: beach placement; blue: nearshore placement; gray: upland/ offshore placement.
8. South Atlantic Division Area of Responsibility.
9. Upland Placement. An amphibious drilling platform (pontoon boat) is used to travel across and collect geotechnical data at a dredged material management site (DMMA) at Kings Bay, Georgia.
10. Environmental Benefits. General Holland visiting Egmont Key, a critically eroding island that supports numerous bird and turtle species. Sediment dredged from Tampa Harbor is used to supplement Egmont Key beaches.
11. Technology. ARGUS camera placed on adjacent building rooftop to monitor the evolution of dredged material, from Ponce Inlet and the Atlantic Intracoastal Waterway, placed in the nearshore in Volusia County, Florida.
12. Science and Collaboration. A wind wave analysis at Kings Bay, Georgia incorporating sea level rise and storm scenarios to inform development of coastal structures.
13. Monitoring. Measuring the depth of thin layer placement during construction to ensure target elevations are met.

Table of Contents

List of Tables

List of Figures

List of Acronyms

AIWW	Atlantic Intracoastal Waterway
BEC&HPP	Beach Erosion Control and Hurricane Protection Project
CAP	Continuing Authorities Program
CBRA	Coastal Barrier Resources Act
CRRP	Cooper River Rediversion Project
CSDR	Coastal Storm Damage Reduction
CSRM	Coastal Storm Risk Management
CY	Cubic Yards
DMMA	Dredged Material Management Area
DMMP	Dredged Material Management Plan
FCCE	Flood Control and Coastal Emergencies
FDEP	Florida Department of Environmental Protection
FRM	Flood Risk Management
GIWW	Gulf Intracoastal Waterway
HSDR	Hurricane Storm Damage Reduction
IWW	Intracoastal Waterway
KITB	Kings Island Turning Basin
MDEQ	Mississippi Department of Environmental Quality
MDMR	Mississippi Department of Marine Resources
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MOA	Memorandum of Agreement
MsCIP	Mississippi Coastal Improvements Program
NAV	Navigation
NED	National Economic Development
NFWF	National Fish and Wildlife Foundation
NPS	National Park Service
NWR	National Wildlife Refuge
O&M	Operations and Maintenance

ODMDS	Ocean Dredged Material Disposal Site
OP	Optimization Pilot
OWW	Okeechobee Waterway
PBH	Palm Beach Harbor
PEH	Port Everglades Harbor
RSM	Regional Sediment Management
RSM RCX	Regional Sediment Management Regional Center of Expertise
SAC	Charleston District
SACS	South Atlantic Coastal Study
SAD	South Atlantic Division
SAM	Mobile District
SAND	Sand Availability and Needs Determination
SAV	Submerged Aquatic Vegetation
SAJ	Jacksonville District
SAS	Savannah District
SAW	Wilmington District
SIBUA	Sand Island Beneficial Use Area
SPP	Shore Protection Project
TLP	Thin Layer Placement
USACE	U.S. Army Corps of Engineers
WRDA	Water Resources Development Act

This page intentionally left blank.

1.0 Executive Summary

Overview

The 2020 South Atlantic Division (SAD) Regional Sediment Management (RSM) Optimization Update builds on the efforts of the 2016 SAD RSM Optimization Pilot (OP) which was developed to help identify additional means to streamline existing processes and ensure solutions are increasingly economical and environmentally sustainable across U.S. Army Corps of Engineers (USACE) authorities and missions. The 2016 effort identified $100 million in annual value to SAD through implementation of RSM strategies and programmatic efficiencies and was awarded the 2016 USACE Innovation of the Year. The 2016 OP was instrumental in advancing RSM, and as a result increased coastal resiliency across the SAD area of responsibility.

Achieving Economical and Environmentally Sustainable Solutions Using RSM Strategies

RSM is a systems approach to deliberately manage sediments in a manner that maximizes natural and economic efficiencies to contribute to sustainable water resource projects, environments, and communities. RSM is accomplished by: recognizing sediment as a valuable resource; developing regional implementation strategies across multiple projects and USACE missions; enhancing relationships with regional stakeholders and partners to better manage sediments; and sharing data, tools, technology, and lessons learned (USACE, 2019). The benefits of RSM are improved sediment management, reduced project lifecycle costs, enhanced partnerships with stakeholders, and more resilient projects.

Economic value is most clearly demonstrated when Flood Risk Management (FRM) and Navigation (NAV) projects are integrated. Economic value from FRM (generally Coastal Storm Risk Management (CSRM); a subcomponent of FRM) and NAV projects can result when a NAV project uses the FRM project as a dredged material placement area or when a FRM project uses a NAV project's channel(s) as a sediment source. Benefits can include a reduced number of mobilizations, conservation of sediment sources and placement areas, potential maintenance of low priority channels, advanced maintenance of navigation channels, and project lifecycle value associated with the NAV and FRM projects. Additional value has been calculated from benefits provided to non-federal projects, such as shore protection benefits, at no additional cost to the Federal Government. Value estimates provided in this report are conservative as they do not include environmental benefits, such as coastal or wetland habitat created, or project lifecycle costs associated with upland or offshore placement sites such as purchasing, permitting, and maintenance.

2020 Update

The 2020 RSM Optimization Update was initiated through the South Atlantic Coastal Study (SACS) to support the identification and continued implementation of sustainable solutions under current authorities. SACS is a regional analysis of coastal risk and an assessment of measures and costs that can address vulnerabilities with an emphasis on RSM as an actionable strategy to sustainably maintain or enhance current levels of coastal storm risk reduction. The goals of SACS are to:

(1) Provide a common operating picture of coastal risk
(2) Identify high-risk locations/focus current and future resources
(3) Identify and assess risk reduction actions
(4) Promote and support resilient coastal communities
(5) Promote sustainable projects and programs, and
(6) Leverage supplemental actions.

The 2020 SAD RSM Optimization Update supports SACS study goals three through six, and in combination with risk reduction strategies identified in additional SACS-related products, provide an extensive suite of measures and opportunities to reduce coastal risk and vulnerability.

Through coordination with all Districts within SAD, the RSM Regional Center of Expertise (RCX) analyzed over 70 coastal NAV and FRM projects in SAD and calculated a $104.2 million annual value from RSM implementation strategies and identified an additional $20 million in RSM opportunities (Figure 1). Annual value to USACE was estimated at $68.8 million for the NAV program, $19.4 million for the FRM program, and $16.0 million to non-USACE partners and stakeholders (e.g., National Park Service, Fish and Wildlife Service, state governments, counties, towns, municipalities, and state/local parks). The RSM strategies that benefit non-USACE partners and stakeholders are the least-cost options for the individual USACE projects, providing cost savings, in addition to fostering positive relationships and coastal resiliency for stakeholders and taxpayers.

Approximately 50% of dredged material from coastal NAV projects in SAD is managed by RSM principles. RSM strategies implemented throughout SAD include beach nourishment, thin layer placement (TLP), open water dispersal/placement in littoral zones, filling dredge holes, littoral zone/nearshore placement, and habitat creation (Figure 2). Of the 50% total SAD dredge volume, 16% (11.4 million cubic yards (CY)) is placed on beaches, 15% is placed in nearshore environments (10.4 million CY), and 19% (13.5 million CY) is placed in estuarine-riverine environments:

- The Charleston District beneficially manages the highest percentage of dredged material at 61%, followed by the Jacksonville District and the Mobile District at 58% and 56%, respectively.
- Charleston Harbor provides the largest RSM value ($37.2 million/year) within SAD with 84% of the value being attributed to the Cooper River Re-diversion Project. The second largest RSM value project in SAD is Mobile Harbor which provides $13.2 million in annual RSM value, primarily through utilization of TLP within Mobile Bay.
- In addition to Charleston and Mobile Harbor, five other projects provide an annual RSM value of $4.0 million or greater which are Tampa Harbor ($5.3 million), Folly Beach – Folly River ($5.1 million), Pinellas Shallow Draft Inlets ($4.8 million), Kings Bay – Nassau County ($4.5 million), and St. Augustine Inlet – St. Johns County ($4.1 million).

The 2016 RSM OP demonstrated most districts within SAD are efficient at placing beach-quality sand from NAV channels onto adjacent beaches, but they are not as efficient at beneficially placing non-beach-quality material (silty sand, mud, clay, rock). Actions taken by SAD since 2016 to increase the beneficial use of non-beach-quality material include the Jekyll Creek Beneficial Use Pilots (TLP, open water

dispersal), nearshore placement of Atlantic Intracoastal Waterway and Ponce Inlet material in Volusia County, FL, and hard bottom and fish habitat creation associated with the deepening of Charleston Harbor. Additional actions to enhance beneficial use within SAD include the Condado Lagoon (San Juan Harbor), Crab Bank (Charleston Harbor), and Deer Island (Biloxi Harbor) projects which were selected as three of the ten national beneficial use pilot projects supported through Section 1122 of the Water Resources Development Act of 2016.

2020 Recommendations

While SAD has been effective at implementing beneficial use and coastal resiliency strategies, the 2020 RSM Optimization Update identified $20 million in additional annual value that could be achieved through implementation of identified RSM strategies. Additional project efficiencies of greater than $1 million per year were identified for Morehead City Harbor, Charleston Harbor, Savannah Harbor, Kings Bay, Canaveral Harbor, and Sarasota County (Figure 1). Significant value and coastal resiliency can be achieved across SAD through placement of sand in the nearshore environment but will require coordination among USACE districts, agencies, and the dredging industry to effectively implement a nearshore placement program. Placement strategies such as nearshore placement, TLP, and open water dispersal should continue to be implemented and refined throughout the Division to support long-term coastal resiliency and USACE programmatic efficiencies. Other RSM placement strategies to explore include wetland restoration and creation, hard-bottom habitat restoration and creation, and filling of relict dredge holes.

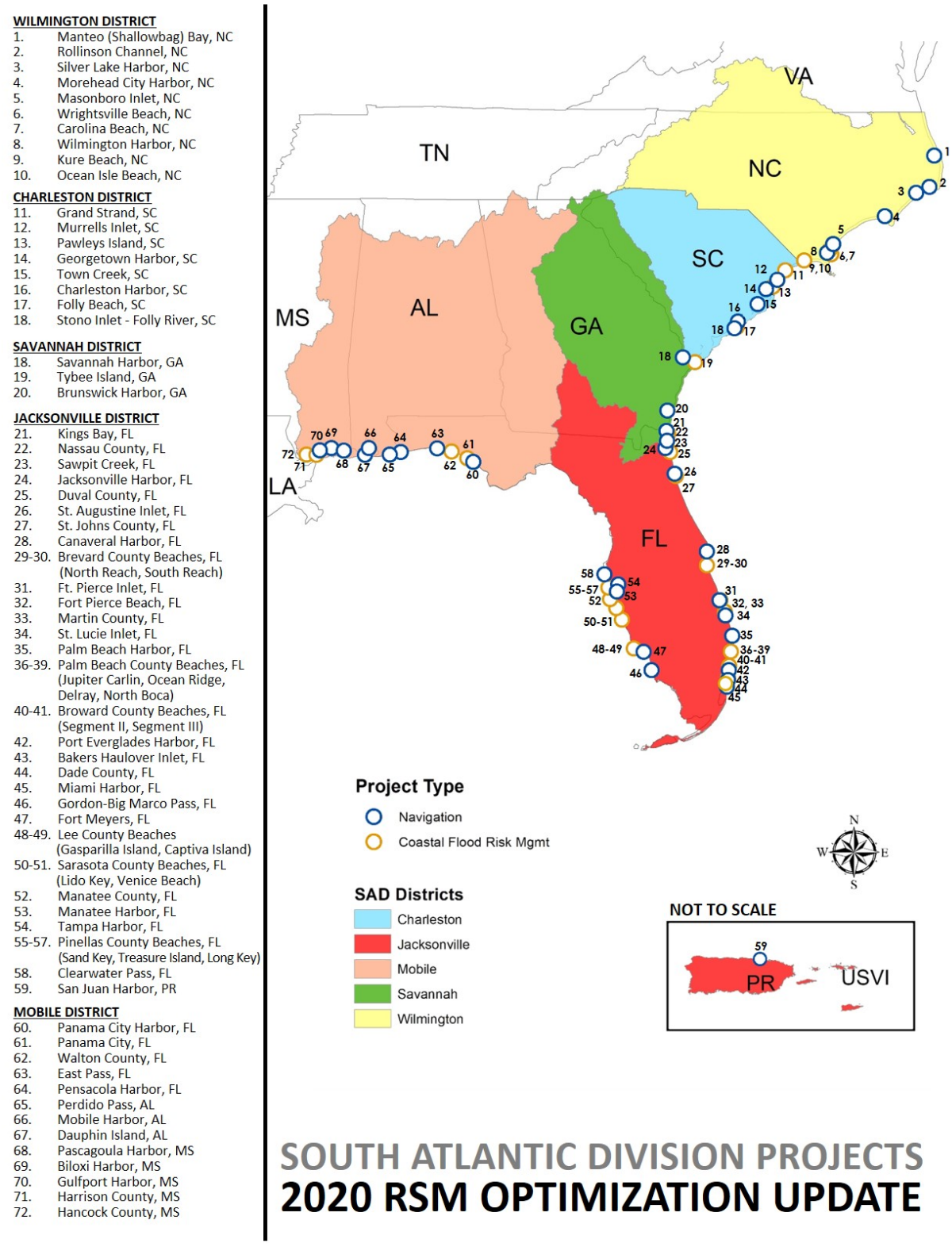


Figure 1. Map of South Atlantic Division coastal Flood Risk Management and Navigation projects analyzed for the 2020 RSM Optimization Update. Intracoastal Waterway projects for all districts were included in the analysis but are not indicated on figure.

2020 SOUTH ATLANTIC DIVISION (SAD)
REGIONAL SEDIMENT MANAGEMENT (RSM) PLACEMENT STRATEGIES

BEACH NOURISHMENT

DEFINITION
Placement of sediment on a beach to rebuild natural systems (e.g., dunes, beaches) and to protect structures and infrastructure (USACE, 2007)*

EXAMPLES
Numerous throughout the South Atlantic Division (SAD).
** How Beach Nourishment Works Primer (iwr.usace.army.mil)*


Beach Nourishment in Northeast Florida

THIN LAYER PLACEMENT

DEFINITION
Placement of thin layers of sediment in an environmentally acceptable manner to achieve a target elevation or thickness (Berkowitz et al., 2019).

EXAMPLES
Marsh: AIWW (GA)
Subtidal: Mobile Harbor (AL); Biloxi Harbor (MS); Gulfport (MS)


Jekyll Creek, AIWW, GA

OPEN WATER DISPERSAL/PLACEMENT IN LITTORAL ZONE

DEFINITION
Placement of sediment in open water littoral zone environments to promote dispersal and distribution of sediments within a coastal system.

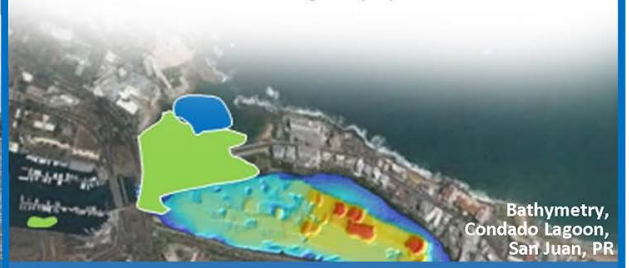
EXAMPLES
- AIWW (GA)
- AIWW Dawhoo Reach (SC)
- Perdido Pass (FL)
- Dauphin Island (AL)


A Barge Used to Disperse Sediment Near the Seafloor

FILLING DREDGE HOLES

DEFINITION
Placement of sediment into submerged depressions previously dredged to provide benefits such as eliminating hypoxic conditions, increasing fish utilization, and/or establishing a healthy benthic community.

EXAMPLES
- Miami Harbor (FL)
- San Juan Harbor - Condado Lagoon (PR)


Bathymetry, Condado Lagoon, San Juan, PR

LITTORAL ZONE / NEARSHORE PLACEMENT

DEFINITION
Placement of sediment in the littoral zone to reduce impacts of coastal storms or to restore habitat.

EXAMPLES
- Morehead City Harbor (NC)
- Town Creek (SC)
- Kings Bay, Nassau County (GA/FL)
- AIWW/ Ponce Inlet, Volusia County (FL)
- Palm Beach Harbor - Midtown (FL)
- Tampa Harbor, Egmont Key (FL)
- Fort Myers Inlet, Fort Myers Beach (FL)
- Perdido Pass (FL)
- Mobile Harbor (AL)
- Pascagoula Harbor (AL)
- Gulfport (MS)


Nearshore Placement in Volusia County, FL

HABITAT CREATION

DEFINITION
Creation of ecosystem features where they did not exist before or modification of an ecosystem to re-establish historical function (Perillo et al., 2019).

EXAMPLES
Bird Habitat*: Manteo (Shallowbag) Bay (NC); Wilmington Harbor (NC); Charleston Harbor (SC); Savannah Harbor (GA); Brunswick Harbor (GA); Tampa Harbor (FL)
Hardbottom Habitat: Charleston Harbor (SC)
Marsh Habitat: Jacksonville Harbor (FL); Pascagoula Harbor (MS); Biloxi Harbor (MS)
Seagrass Habitat: Miami Harbor (FL)

** Beach nourishment projects provide additional habitat across the South Atlantic Division (for both birds and turtles).*


Egmont Key Bird Sanctuary, Tampa Bay, FL

Figure 2. RSM strategies implemented in SAD.

2.0 Introduction

The 2020 RSM Optimization is an update of the 2016 SAD RSM OP which was developed to help define additional sustainable solutions across USACE missions and to support regional implementation strategies across project business lines. The goals of the 2016 OP were to: (1) develop and provide an actionable and optimized RSM strategy at the USACE Division-level to most efficiently execute the coastal NAV and FRM program budgets, and (2) maximize the amount of dredging while increasing the amount of implemented RSM projects to create value for the nation. The 2016 effort identified $100 million in annual value to SAD through implementation of RSM strategies and programmatic efficiencies and was awarded the 2016 USACE Innovation of the Year. The 2016 OP was instrumental in advancing RSM and coastal resiliency in SAD.

The 2020 RSM Optimization Update and the South Atlantic Coastal Study

The 2020 RSM Optimization Update was implemented as a component of SACS. SACS is a regional analysis of coastal risk and an assessment of measures and costs that can address vulnerabilities with an emphasis on RSM as an actionable strategy to sustainably maintain or enhance current levels of coastal storm risk reduction. The study is a collaborative effort with a diverse group of partners and stakeholders to address coastal storm risks, by providing data, tools, and a framework to evaluate increased hurricane and storm damages as a result of sea level rise. The study area includes over 65,000 miles of tidally influenced shorelines throughout SAD of USACE (Figure 3).

The goals of SACS are to: (1) provide a common operating picture of coastal risk, (2) identify high-risk locations to focus current and future resources, (3) identify and assess risk reduction actions, (4) promote and support resilient coastal communities, (5) promote sustainable projects and programs, and (6) leverage supplemental actions. The key products to achieve the study goals include a risk assessment, RSM Optimization Update, the Sand Availability and Needs Determination (SAND), Coastal Hazards System, and state/territory appendices. The Coastal Hazards System is a suite of storm models and the state appendices include identified focus areas to reduce coastal risk, data used to assess risk (e.g., population, infrastructure, environmental, cultural, social data), and risk reduction strategies.

Figure 3. Map of the South Atlantic Coastal Study area highlighting 65,000 miles of tidally influenced shorelines in the continental U.S., Puerto Rico, and the Virgin Islands.

The 2020 RSM Optimization Update supports SACS study goals three through six. The Update, in combination with the risk reduction strategies identified in the SACS state appendices, provides an extensive suite of opportunities to reduce coastal risks and vulnerability.

Benefits of RSM Strategies and Valuation

RSM is a systems approach to deliberately manage sediments in a manner that maximizes natural and economic efficiencies to contribute to sustainable water resource projects, environments, and communities. RSM is accomplished by: recognizing sediment as a valuable resource; developing regional implementation strategies across multiple projects and business lines; enhancing relationships with regional stakeholders and partners to better manage sediments; and sharing data, tools, technology, and lessons learned. Benefits of RSM are improved sediment management, reduced lifecycle costs, enhanced partnerships with stakeholders, and more resilient projects and coastal communities. Maximizing natural and economic efficiencies is critical to maintaining sustainable water resource projects as the total volume of USACE dredging has remained relatively stable over the past several decades while the cost of dredging has increased substantially (Figure 4).

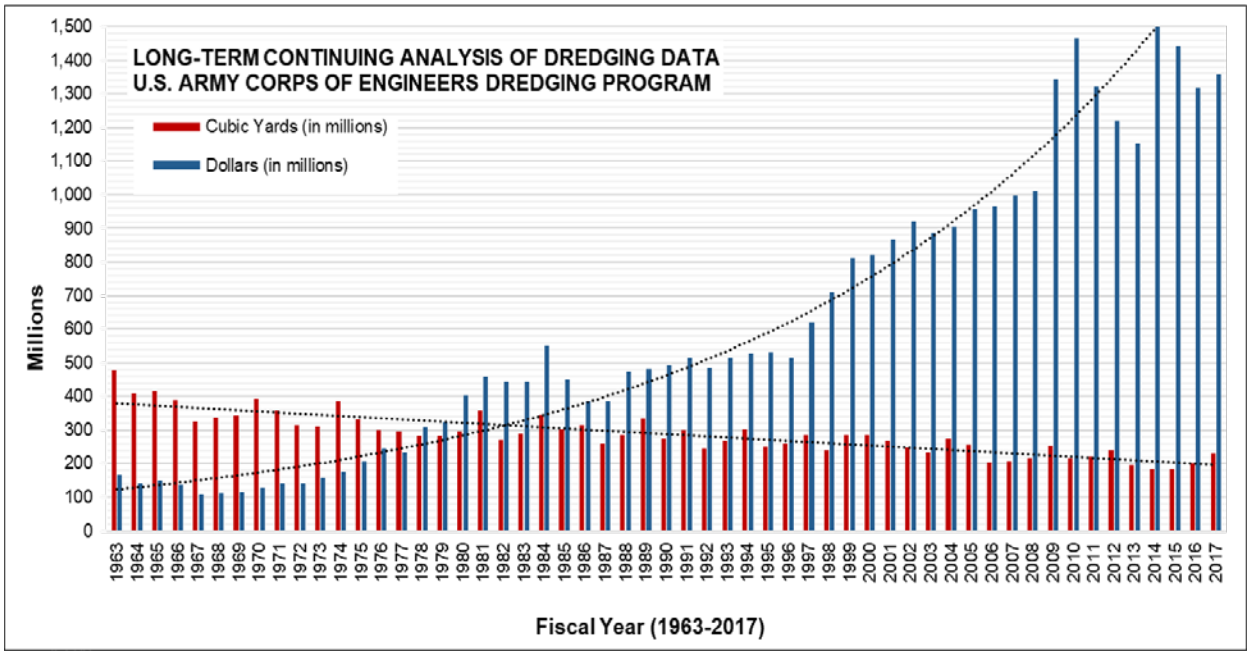


Figure 4. USACE dredging volumes and costs (1963 – 2017). Note significant increase in cost starting in the 1990s.

RSM principles and strategies have been explored and implemented in many Districts, but until the 2016 SAD RSM OP, USACE had not taken a comprehensive approach to define RSM opportunities for all projects or quantify economic benefits for an entire division. By placing beach-quality material dredged from NAV projects onto adjacent beaches, the Jacksonville District (SAJ) estimated $27 million in economic value associated with implementing and executing RSM strategies for the 2013 Flood Control and Coastal Emergencies (FCCE) Act projects within SAJ (Table 1). Estimated value was calculated by multiplying the total volume of navigation dredging material placed on the beaches by typical costs per cubic yard (CY) for the individual projects. This simplistic approach documents significant value by estimating one-time value to the shore protection projects, but does not account for numerous other areas of value to both the NAV and FRM programs.

For the purposes of this report, the terms FRM, Coastal Storm Risk Management (CSRM), Coastal Storm Damage Reduction (CSDR), Shore Protection Project (SPP), Hurricane Storm Damage Reduction (HSDR), and Beach Erosion Control and Hurricane Protection Project (BEC&HPP) are used interchangeably. RSM value is attributed to the FRM program in all cases and terminology for individual projects is based on the district's preferred nomenclature.

Table 1. Summary of Navigation Costs, Volume (CY) of Beach-quality Material Placed on Florida Beaches, and Estimates of Value Associated with Executed 2013 SAJ FCCE Projects Utilizing RSM Strategies.

FY13 NAVIGATION RSM	TOTAL COST (NAV)	PLACEMENT	BEACH VOLUME (CY)	ROUGH VALUE TO FRM
Port Everglades* (partial)	$ 1,898,489	Broward County SPP	96,126	$ 5,959,812
Palm Beach Harbor	$ 4,870,074	Palm Beach County NF	420,000	$ 6,300,000
Fort Pierce Inlet	$ 3,299,090	Fort Pierce SPP	191,000	$ 2,330,200
St Lucie Inlet	$ 6,465,600	Martin County SPP	200,000	$ 3,000,000
St Augustine Inlet	$ 1,932,600	St Johns County SPP	116,000	$ 696,000
Ponce Inlet	$ 1,000,000	St Lucie County SPP NS	141,000	$ 2,115,000
AIWW*-Jupiter Inlet	$ 2,601,207	Palm Beach County	55,000	$ 825,000
AIWW-Baker's Haulover		Dade County SPP	120,00	$ 6,180,000
Total	**$ 22,067,060**			**$ 27,406,012**
Kings Bay EC (Navy)	$ 8,030,480	Nassau County SPP	121,046	$ 1,361,768

*AIWW = Atlantic Intracoastal Waterway

Economic value for FRM and NAV projects can result when a NAV project uses the FRM project as a placement area or when a FRM project uses a NAV project's channel(s) as a material source. Benefits include a reduced number of mobilizations, conserved capacity of sand sources and placement areas, potential maintenance of low priority channels, advanced maintenance of navigation channels, and project lifecycle value associated with the FRM project. In some cases, placement of beach-quality material from NAV projects onto FRM projects can eliminate the need for the individual FRM project or, conversely, the need to dredge NAV projects with Operations and Maintenance (O&M) funds.

Another area of value associated with RSM, although difficult to quantify, is the principle that sediment is a valuable resource and should be maintained in the active sediment system. For example, if dredged material that is suitable for placement on a beach, in a nearshore environment, or for another beneficial use, is disposed of in a Dredged Material Management Area (DMMA) or Ocean Dredged Material Disposal Site (ODMDS), the value of the material is essentially lost due to the fact that recovery of the material is not economical in most cases. Maintaining sediment in the active sediment system is a tool to increase the resiliency of coastal communities throughout the U.S. where coastal storms, sea level rise, subsidence, and erosion threaten their long-term sustainability.

The total costs of DMMA and ODMDS permitting and maintenance was not included in this analysis. Purchasing, permitting, developing, and maintaining both of these types of placement options is expensive and time consuming (e.g., hydrographic surveys and sediment testing for an ODMDS and dike raising, ditching/dewatering, invasive species management, offloading, cutting grass, and debris removal for a DMMA). By assuming that every CY of dredged material placed on a beach, in a nearshore area, or within another beneficial use location saves the equivalent capacity at an upland or offshore placement area, we can estimate project lifecycle cost benefits for the RSM strategy. Value associated with conservation of upland and offshore placement areas is high and will only increase considering the growing cost of real estate adjacent to navigable waterways and estuaries, in addition to the costs to permit and maintain them.

As an example, the RSM Regional Center of Expertise (RCX) recently evaluated the true cost of upland placement in Jacksonville Harbor based on all direct and incidental (e.g., lifecycle) costs. The Jacksonville Harbor analysis estimated lifecycle costs to be 12–14% of all project costs, which is significant as it suggests that analyses that do not include incidental costs for DMMA placement when assessing least-cost placement alternatives are likely underestimating total project costs by greater than 10% in Jacksonville Harbor. Considering that RSM placement strategies generally do not have incidental costs, analyses that include an RSM strategy within 10–15% of the cost of DMMA placement should receive additional consideration as the least-cost placement alternative in Jacksonville Harbor. Additional analyses conducted by the Mobile (SAM) and Philadelphia Districts demonstrate offloading of DMMAs is on the order of $20/CY in the Mobile District and $50/CY along the Intracoastal Waterway (IWW) in the Philadelphia District.

Quantification of environmental benefits, as a result of beneficially using dredged material, is difficult. Environmental benefits that arise from incorporating RSM into projects include the development of island habitats, TLP in marshes, filling of relic dredge holes, development of seagrass beds, and maintenance of beaches for bird and turtle nesting habitat. Environmental benefits and ecosystem value are often based on replacement costs (e.g., mitigation banks) or total economic value which includes use value (direct and/or indirect) and non-use value (option, bequest, existence) (Smith et al., 2006). Valuation of environmental resources is a growing discipline with numerous approaches and methodologies to assess value (National Ocean Economic Program, 2015; Pendleton, 2009). RSM value associated with environmental benefits is calculated based on the difference in placement costs relative to offshore or upland placement options, when appropriate. Additional environmental value could be estimated based on quotes from local mitigation banks for comparable habitat.

The 2020 Update

This report documents RSM strategies that have been implemented throughout SAD, as well as additional RSM opportunities that have been identified by individual districts in coordination with the RSM RCX. The report also estimates value associated with coupled business line (e.g., NAV-FRM) RSM projects relative to traditional independent projects documenting the Value to the Nation provided by RSM and potential areas for increased efficiency. The report does not attempt to quantify total

environmental benefits and, as a result, underestimates the total value provided by RSM implementation.

The report is designed as a comprehensive document with short and concise standalone chapters and sub-chapters so the reader can quickly and easily review individual projects, district summaries, and division information.

3.0 Methods

A template was developed to define all potential placement options for dredged material from NAV projects and source material for all coastal FRM projects within SAD. The template included means to capture cost and relevant environmental/permitting data for each project. The goal of the template was to develop a consistent approach to defining RSM opportunities and quantifying value across regional sediment systems that vary significantly in size, geomorphology, hydrology, sediment dynamics, and management approaches.

The template was divided into three sections (Project Data, Cost Engineering Data, Environmental/Permitting Data). The major categories under each section are provided in Table 2. In general, project data was provided by project managers, operations managers, and engineering technical leads. The cost engineering data focused on dredge contract data and estimates provided by cost engineers. Environmental/permitting data was provided by project managers and planning personnel. Project dredge intervals and volumes vary significantly based on natural events such as storms and nor'easters. Fiscal constraints and values provided in the report are generalized averages based on project histories.

Table 2. List of Data Inputs for Optimization Template to Define RSM Opportunities and Quantify Value of Implemented RSM Projects and Potential RSM Opportunities.

Project	Cost Engineering	Environmental/Permitting
Project Name	Cost Per Cubic Yard - CY (dredge and place)	Shovel Ready?
Type of Material and Location	Mobilization/Demobilization Costs	Time to Shovel Ready
Dredge/Nourish Interval	Total Contract Costs	Cost to Shovel Ready
Most Recent Year of Activity	Dredge Type	Dredging Windows/Restrictions
Borrow/Placement Options	Cost Assumptions	Year Permitted
		Year Permit Expires

After completing the template, beneficial uses of sediments by sediment type (e.g., beach-quality, nearshore-quality, other sediment such as silt, mud, clay, rock) were determined and the value of the RSM beneficial use of dredged material strategies was estimated relative to traditional placement options (e.g., DMMA, ODMDS). Additional estimates of value were calculated based on the one-time value of material placed on a beach or nearshore environment (traditional cost per CY x volume placed) or the project lifecycle benefits associated with the beneficial use placement (e.g., extending dredging or nourishment intervals). Several projects throughout SAD do not have traditional offshore or upland placement options and the only economically viable placement option is beneficial use (open water in active sediment system, beach, nearshore). In these particular cases, the beneficial use strategies are highlighted, but RSM value was not quantified.

An example of value relative to traditional placement options is provided in Table 3.

- Beach-quality material is dredged annually from Kings Bay and could be placed in an ODMDS at an estimated cost of $6.7 million. The Nassau County SPP could be nourished from an offshore borrow source every five years at an annualized cost of $4.3 million for a combined annual cost of $11.0 million (NON-RSM 1).
- The RSM 1 strategy is to place the beach-quality material dredged from the channel onto the Nassau County SPP at a cost of $7.1 million annually.
- The RSM 1a strategy is to distribute the beach-quality dredged material at Fort Clinch, a Civil War era cultural resource managed by the Florida State Parks system, per legal agreement with the U.S. Navy.

By utilizing both of the RSM strategies, SAJ realizes an estimated annual value of $3.5 million as a result of beneficially using dredged material. The value in this particular case is primarily from eliminating dredge plant mobilization and by minimizing the in-house labor to plan and execute the two separate projects. In this situation, effective resource management reduces, and likely eliminates, the need for the traditional Nassau SPP to support coastal storm risk management in the project area.

Table 3. Summary of Costs and Value of Beach-quality Material for Projects at Kings Bay and Nassau County.

Project Type	Source to Sink	Interval (Year)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Kings Bay to ODMDS	1	$10	350,000	$0.5	$2.7	$6.7	$6.7
SPP 1	Borrow Area to Nassau SPP	5	$11	1,500,000	$1.5	$3.3	$21.3	$4.3
NON-RSM 1	Combined Traditional NAV and SPP Projects						$28.0	$11.0
RSM 1	Kings Bay to Nassau SPP North	2	$25	350,000	$0.5	$4.9	$14.2	$7.1
							RSM Value Strategy 1:	$3.9
*RSM 1a	Kings Bay to Ft. Clinch	2	$13	150,000			$2.0	$1.0
	OTHER Benefit A	2	$11	112,500			$1.2	0.6
							TOTAL Combined RSM Value Strategies 1-1a:	**$3.5**

RSM value is based on the removal of the traditional SPP as sufficient beach-quality material is placed on the beach from the NAV project ($11.0 M – 7.1 M = $1.5 M) plus the value of placement on the non-federal beach at Fort Clinch (0.6 M minus the additional cost of placement at Fort Clinch of $1.0 M).

Value for RSM 1 is split equally between NAV and FRM programs as NAV is required to mitigate the FRM project at 50%. OTHER Benefit A was estimated based on the volume of sand placed on the beach from RSM 1a (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

*The overall RSM strategy is a combination of Fed-Fed and Fed-State projects as Fort Clinch is a state park and placement is required at Fort Clinch per legal agreement with U.S. Navy.

Data tables are provided for all projects and are color-coded to correspond to RSM preferred and non-preferred source to sink diagrams provided in each fact sheet (Figure 5). Preferred RSM pathways are illustrated in green and non-preferred pathways are in red.

The Fort Pierce Harbor Navigation project and Fort Pierce SPP illustrate the value of one-time placement and lifecycle benefits associated with RSM projects (Table 4).

- Approximately 200,000 CY of beach-quality material from Fort Pierce Harbor is beneficially placed on the Fort Pierce SPP every five years at an annualized cost of $1.0 million per year (RSM 1).
- The value of placing 200,000 CY of beach-quality sand on the SPP at no cost to the SPP is $0.4 million/year (NAV and FRM Benefit A), assuming 75% of material is placed on the beach at an estimated cost of $15/CY.
- An additional value of $0.4 million/year (NAV and FRM Benefit B) was attributed to the SPP based on the assumption that the 150,000 CY accounts for approximately 30% of the material required to adequately maintain the SPP.
- The additional material increases the nourishment interval from four to five years and reduces the price of the SPP from $2.0 million/year to $1.6 million/year for a project lifecycle benefit of $0.4 million/year.

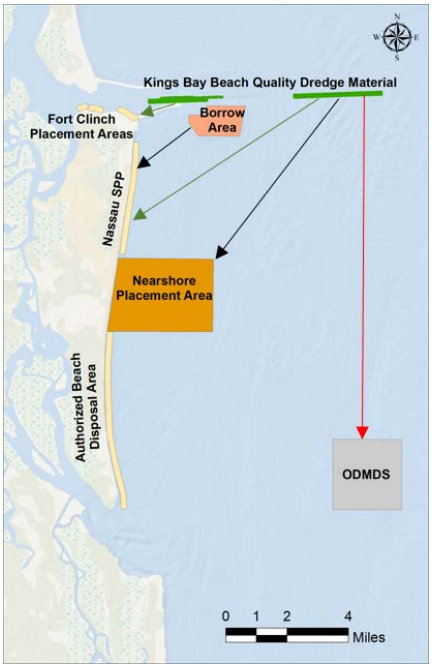


Figure 5. Standard source-to-sink diagram (Kings Bay-Nassau County) provided in each fact sheet documenting RSM preferred (green arrows) and non-preferred (red arrows) strategies.

While the cost of placement on the beach is more expensive than placement at the ODMDS (NAV 1), the total cost of maintaining both the NAV and FRM projects provides $0.5 million/year in value relative to the individual traditional projects after accounting for the additional $0.3 million to execute the RSM 1 strategy. The benefits are attributed to both the NAV and FRM program due to required mitigation from downdrift impacts associated with the Fort Pierce Harbor project.

Table 4. Summary of Costs and Value of Beach-quality Material for Project at Fort Pierce.

Project Type	Source to Sink	Interval (Year)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Ft. Pierce Harbor to ODMDS	5	$18	200,000	$0.7	$0.8	$5.1	$1.0
SPP 1	Offshore Borrow to Ft. Pierce SPP	4	$12	400,000	$0.9	$2.1	$7.8	$2.0
RSM 1	Ft. Pierce Harbor to Ft. Pierce SPP	5	$15	200,000	$0.7	$2.8	$6.4	$1.3
	NAV and FRM Benefit A	5	$12	150,000			$1.8	$0.4
	NAV and FRM Benefit B							$0.4
							TOTAL Combined RSM Value Strategy 1:	**$0.5**

NAV and FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

NAV and FRM Benefit B was estimated assuming the RSM project provides 30% of the needed volume to maintain shoreline protection at the SPP (120,000 CY of 431,000 CY every four years). The additional 30% of material would increase the project interval from four to five years and reduce the annual cost for a net value of $0.4 M.

Total RSM value of $0.5 M calculated by adding NAV and FRM Benefits A and B and subtracting the additional cost of RSM 1 from NAV 1.

4.0 South Atlantic Division (SAD) Summary

Overview

NAV and FRM projects managed by SAD were analyzed for economic and environmental efficiencies of placement and beneficial use of dredged material (see Figure 1 for reference). Implementation of RSM principles currently provides an estimated $104.2 million in annual value to SAD (Figure 6). Based on data from NAV projects throughout the Division, an estimated 70.6 million CY is dredged per dredge cycle (maintenance interval) and 50% of the material is managed by RSM principles.

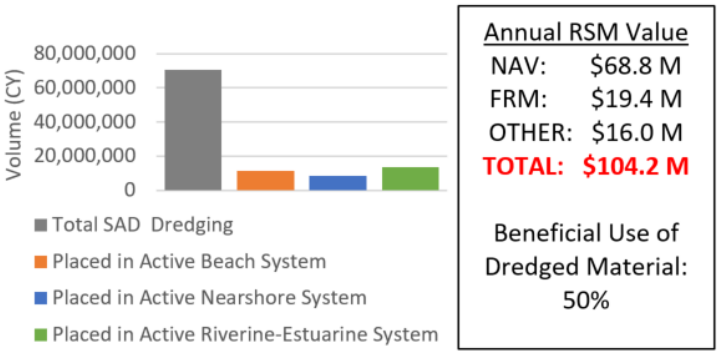


Figure 6. Average volume of sediment dredged from SAD NAV projects per standard project dredge cycles. Implemented RSM strategies provide $104.2 million in total annual value.

RSM Value and Sediment Placement

Of the NAV projects within SAD, the Charleston District (SAC) beneficially places the highest percentage of dredged material per dredge cycle at 61%, followed by the Jacksonville and Mobile districts at 59% and 56%, respectively (Table 5). Charleston Harbor provides the largest RSM value within SAD, accounting for $37.2 million of the $44.5 million total annual RSM value within SAC, with 84% of that value being attributed to Charleston Harbor's Cooper River Rediversion Project (CRRP). The CRRP rediverts flow (water and sediment) from the Cooper River back to its natural location on the Santee River. The second largest RSM value project within SAD is Mobile Harbor. Mobile Harbor provides $13.2 million in RSM value primarily through utilization of TLP within Mobile Bay. Five additional projects provide an annual RSM value of $4.0 million or greater, including Tampa Harbor (SAJ, $5.3 million), Folly Beach – Folly River (SAC, $5.1 million), Pinellas Shallow Draft Inlets (SAJ, $4.8 million), Kings Bay – Nassau County (SAJ, $4.5 million), and St. Augustine Inlet – St. Johns County (SAJ, $4.1 million). Other projects within SAD that provide over $2 million in annual RSM value include Morehead City Harbor (Wilmington District, SAW), Wilmington Harbor (SAW), Baker's Haulover (SAJ), and Fort Myers Inlet (SAJ).

Table 5. Total Dredge Volume and Value of RSM Implemented through NAV-FRM Projects in SAD.

District	*Total Dredge Volume (CY)	% Managed Using RSM Strategies	Annual RSM Value ($ M)
SAD Total	**70,840,000**	**50%**	**$104.2**
Charleston District Total	19,430,000	61%	$44.5
Jacksonville District Total	9,965,000	59%	$30.6
Mobile District Total	21,745,000	56%	$17.3
Savannah District Total	9,800,000	11%	$0.8
Wilmington District Total	9,900,000	43%	$11.0

*Total dredge volume calculated as the sum of all material dredged from NAV projects per dredge cycle.

Of the 50% of material managed through RSM principles, 16% (11.4 million CY) is placed on beaches, 15% is placed in nearshore environments (10.4 million CY), and 19% (13.5 million CY) is placed in estuarine-riverine environments (Figure 7). The Wilmington and Jacksonville Districts beneficially place the most material on beaches with a total volume per dredge cycle of 4.3 million CY each. The Mobile District places the most material in nearshore environments, followed by the Jacksonville District, with total volumes of 8.5 and 1.6 million CY, respectively. Finally, the Charleston District beneficially places the most material in estuarine-riverine environments at 9.7 million CY per dredge cycle, followed by the Mobile District at 2.8 million CY.

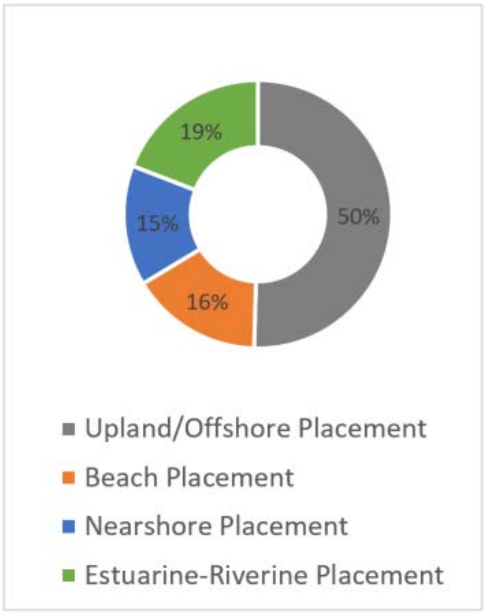


Figure 7. Distribution of placement by category for material dredged from SAD NAV projects.

Taking Action after the 2016 Optimization Pilot

The 2016 RSM OP demonstrated that, although most districts within SAD are efficient at placing beach-quality sand from NAV channels onto adjacent beaches, they are not as efficient at beneficially placing non-beach-quality material (silty sand, mud, clay, rock). The Mobile District, however, does execute several RSM strategies for placing non-beach-quality material, including open water placement and TLP. These are two typically low-cost placement strategies that keep sediment in the active system and save available capacity in upland and offshore placement sites. While the Mobile District is located along the Gulf of Mexico and is hydrodynamically different than districts located on the Atlantic Ocean (i.e., lower tidal range and lower wave energy), properly executed TLP and open water placement could provide benefit at other project locations throughout SAD.

To support the expansion of beneficial use placement of non-beach-quality material and to develop long-term environmentally acceptable, economically viable solutions across SAD, the Jekyll Creek, GA Beneficial Use Pilot Projects were implemented in 2019. The pilot projects beneficially used Atlantic Intracoastal Waterway (AIWW) dredged material for TLP of approximately 5,000 CY on the marsh at Jekyll Island and open water dispersal of approximately 210,000 CY at the mouth of St. Simons Sound (Figure 8). The pilot projects were a successful collaboration between the Savannah District (SAS), SAJ, RSM RCX, Georgia Department of Natural Resources, Jekyll Island Authority, The Nature Conservancy, and Atlantic Intracoastal Waterway Association. Completed in the summer of 2019, the projects provided potential beneficial use solutions for mud, muck, and silty material for coastal Georgia and along other coastal areas of SAD.

Figure 8. Jekyll Creek TLP site on Jekyll Island (top) and a barge at mouth of St. Simons Sound used to support open water dispersal (bottom).

The 2016 OP also indicated nearshore placement of material as another option to increase programmatic efficiency and reduce flood risks throughout SAD. Nearshore placement provides value, but primarily to the NAV program as a function of distance to other placement options. The FRM benefits are often limited because nearshore placement areas often extend beyond the depth of closure and the material is not placed in the littoral zone where it could provide shore protection benefits via dampening of wave energy. Districts should consider prioritizing nearshore placement in the littoral zone both for established placement areas and development of new placement areas. This is an area of interest within the coastal engineering and research community, and could become a more desirable strategy. Implementation will require significant coordination and collaboration among USACE, state and federal agencies, and the dredging industry; placement in the nearshore is challenging and such projects throughout SAD have received limited bids from the dredging industry. Benefits include less equipment on the beach during placement, less impact to birds and nesting sea turtles, and less stringent silt content limitations.

To support advancement of nearshore placement, the Jacksonville District collaborated with the USACE Engineer Research and Development Center's Field Research Facility to monitor placement of 400,000 CY of beach-quality sand in the nearshore of Volusia County, FL. The sand was dredged from the AIWW and Ponce Inlet in 2018/19. The project was monitored with an ARGUS camera system that evaluated shoreline position, surf zone width, nearshore bar location, and derived bathymetry. The ARGUS camera system set-up and example imagery illustrating shoreline position and the nearshore bar location is provided in Figure 9.

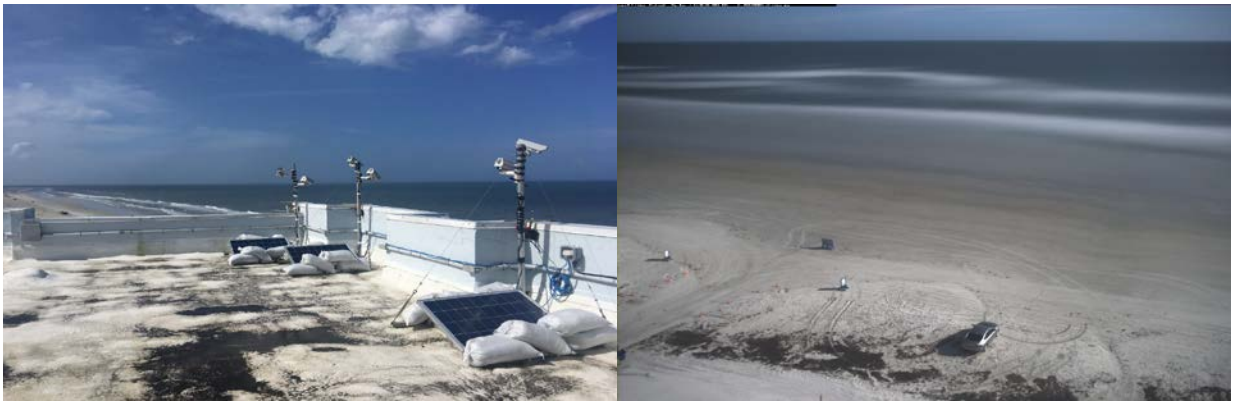


Figure 9. The ARGUS camera system installed on the roof of a condominium in Volusia County, FL (left), and example ARGUS imagery documenting shoreline position and nearshore bar location indicated by white areas (right).

Opportunities exist for beneficial use of dredged materials and RSM in both O&M NAV and FRM projects and new construction and harbor deepenings. Recent and active deepening projects include Charleston Harbor, Savannah Harbor, Jacksonville Harbor, and Miami Harbor. The Charleston District is currently dredging parts of Charleston Harbor to 52 feet as part of the Charleston Harbor Post 45 Deepening Project. RSM opportunities incorporated into the Charleston Harbor project include the use of Entrance Channel rock for the construction of eight reefs, adding to the South Carolina Department of Natural Resources reef, and construction of a perimeter berm for the ODMDS which provides hard bottom and fish habitat (Figure 10). Sediment from Charleston Lower Harbor will be placed on the Crab Bank Bird Sanctuary, and sandy sediment dredged from the Entrance Channel or Inner Harbor Anchorage Basin will be placed at the south jetty terminus on Morris Island to offset erosion.

Figure 10. Image from USA Today Special Edition: U.S. Army Corps of Engineers (2019) highlighting beneficial use of Charleston Harbor Entrance Channel rock used for construction of eight artificial reefs and a perimeter berm that will provide hard bottom habitat.

The Mile Point Navigation Project in Jacksonville Harbor (FL) is another example of beneficial use associated with a harbor deepening. The Mile Point Project is located on the southern side of the intersection of the St. Johns River and the AIWW in Jacksonville Harbor. The project restored 52 acres of salt marsh habitat using 900,000 CY of dredged material, and built additional capacity for future habitat creation using dredged material from Jacksonville Harbor. A final example is Miami Harbor, where the Jacksonville District placed 560,000 CY of dredged material from the deepening in a dredge hole north of the harbor, creating over 15 acres of seagrass habitat. The dredged material was capped with 85,000 CY of select fill and planted with native seagrasses.

The 2020 RSM Optimization Update and Additional Opportunities for Action

Recent efforts by USACE and SAD to support coastal resiliency, beneficial use of dredged material, and programmatic efficiencies through the NAV and FRM business lines have been successful. While progress has been made, the 2020 RSM Optimization Update identified $20 million in annual value that could be achieved through implementation of RSM strategies. Additional efficiencies of greater than $1 million per year were identified for Morehead City Harbor (SAW), Charleston Harbor (SAC), Savannah Harbor

(SAS), Kings Bay (SAJ), Canaveral Harbor (SAJ), and Sarasota County beaches (SAJ). Placement strategies such as TLP, open water dispersal, and nearshore placement should continue to be implemented and refined throughout the division. Other placement strategies to explore include wetland creation, hard bottom habitat creation, and filling relict dredge holes.

To encourage beneficial re-use, Congress passed Section 1122 of the WRDA 2016, consisting of 10 pilot projects for the beneficial use of dredged material. The competitive program included nearly 100 proposals. SAD was awarded three projects: Deer Island (Biloxi Harbor), Condado Lagoon (San Juan Harbor), and Crab Bank (Charleston Harbor). The recently completed Deer Island Lagoon Project restored aquatic ecosystem habitat, reduced storm damage to property and infrastructure, and supported risk management adaptation strategies. The Condado Lagoon and Crab Bank projects should be constructed in the next two years, provided funding is available. The Condado Lagoon Project will fill relict dredge holes to restore aquatic ecosystem habitat and promote recreation. The Crab Bank Project will restore aquatic ecosystem habitats, reduce storm damage to property and infrastructure, and promote recreation.

An area of recent focus is beneficial use of dredged material placed in upland placement areas (e.g., DMMAs). There are approximately 600 DMMAs within SAD. Development and management of the areas requires significant human and financial resources and valuable sediment is often wasted. As part of SACS, USACE is developing a comprehensive database characterizing all DMMAs and identifying beneficial uses and potential end users of the dredged material. Recent successes include the use of Jacksonville Harbor (FL) material for road construction; beneficial use offloading to build a park in Manatee County (FL); and emergency management (e.g., berms, public access filling) in advance of hurricanes. Additional uses could include construction of coastal resiliency features such as wetland creation and/or restoration and development of dikes and levees. The benefits of a DMMA program that operates using RSM principles and strategies, include enhancing coastal resiliency, reducing upland placement requirements, saving money, and strengthening partnerships with stakeholders.

4.1 Wilmington District (SAW)

The RSM Optimization Update analyzed 11 projects in the Wilmington District including seven NAV projects and four FRM projects (Figure 11).

4.1.1 Summary of Navigation and Flood Risk Management Projects

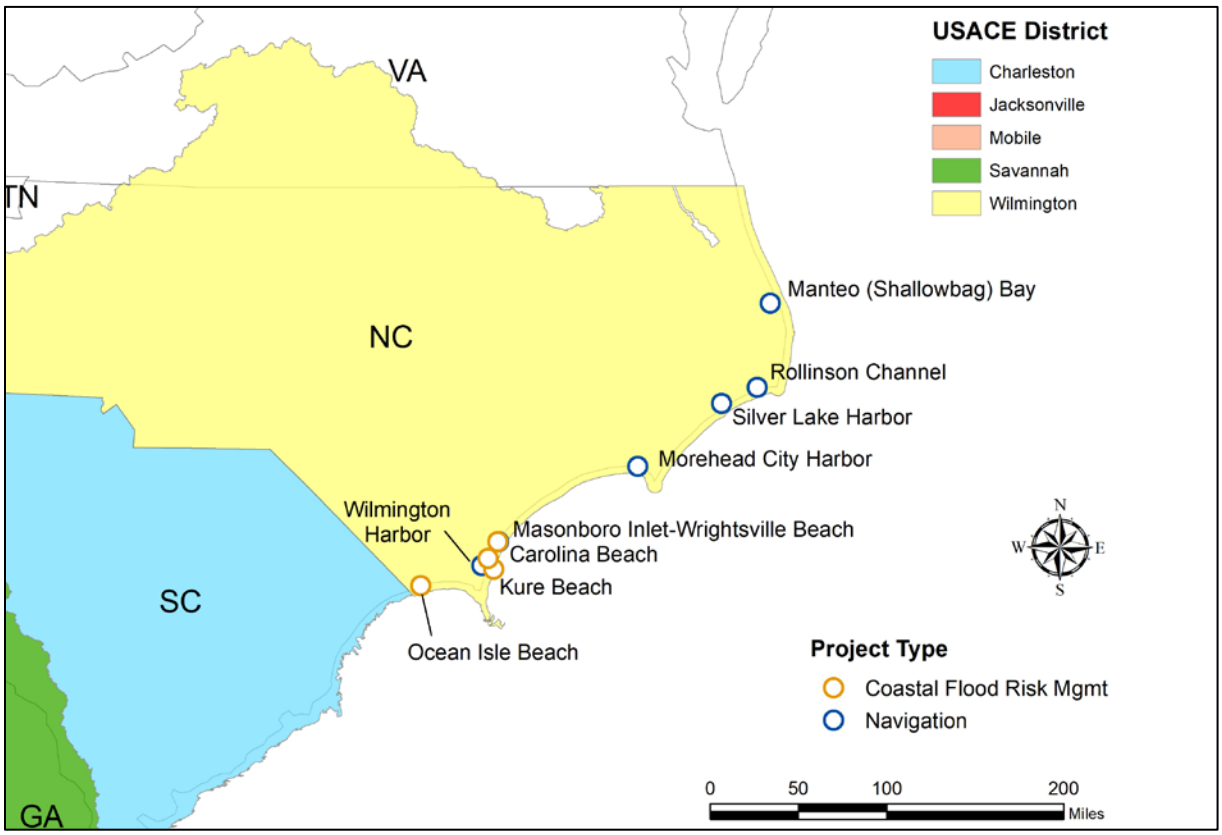
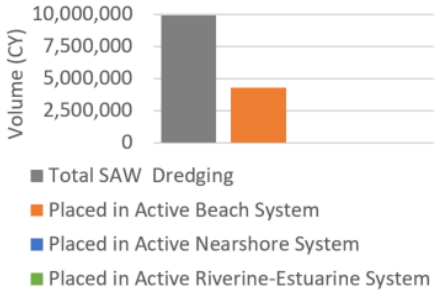


Figure 11. Map of Wilmington District projects analyzed under the 2020 SAD RSM Optimization Update. Note: the AIWW is not included in the map.

Overview

NAV and FRM projects managed by the Wilmington District were analyzed for economic and environmental efficiencies of placement and beneficial use of dredged material. Implementation of RSM principles provides an estimated $11.0 million in annual value to the Wilmington District (Figure 12). Based on data from five NAV projects in the Wilmington



Annual RSM Value	
NAV:	$1.7 M
FRM:	$1.3 M
OTHER:	$8.0 M
*TOTAL:	$11.0 M

Beneficial Use of Dredged Material: 43%

Figure 12. Average volume of sediment dredged from SAW NAV projects per standard project dredge cycles. Total annual RSM value is $11 million.

District, an estimated 9.9 million cubic yards (CY) is dredged per dredge cycle and 43% of the material is managed by RSM principles.

RSM Value and Sediment Placement

Of the Wilmington District NAV projects, Masonboro Inlet, Manteo (Shallowbag) Bay, Rollinson Channel, and Silver Lake beneficially places 100% of the projects' dredged material and Atlantic Intracoastal Waterway (AIWW) beneficially places 60% of the project's dredged material (Table 6).

The highest dredge volume for the Wilmington District comes from Wilmington Harbor. Approximately 38% of all Wilmington District dredged volume is removed from Wilmington Harbor channels and provides 35% of Wilmington District's annual RSM value ($3.8 million).

The two next highest dredge volume projects are at Morehead City and Manteo (Shallowbag) Bay/Rollinson/Silver Lake along the Outer Banks, removing 3.9 million CY and 1.1 million CY from project channels per dredge cycle, respectively, for a total combined annual RSM value of $3.1 million. An additional $6 million in annual value could be realized if dredged material from Morehead City Harbor could be efficiently placed in the littoral system. The Ocean Isle FRM project receives 100% of material from Shallotte Inlet.

Table 6: Total Dredge Volume and Value of RSM Implemented through NAV-FRM Projects in SAW.

Project	*Total Dredge Volume (CY)	% Managed Using RSM Strategies	Annual RSM Value ($ M)
SAW Total	**9,900,000**	**43%**	**$11.0**
Morehead City Harbor	3,900,000	28%	$2.8
Manteo (Shallowbag) Bay, Rollinson, Silver Lake	1,100,000	100%	$0.3
AIWW	300,000	60%#	$1.1
Masonboro Inlet-Wrightsville Beach	800,000	100%	$1.7
Wilmington Harbor	3,800,000	26%	$3.8
Carolina Beach-Kure Beach		38%	$1.3
Ocean Isle Beach		100%	$0.0

*Total dredge volume calculated as the sum of all material dredged from NAV projects per dredge cycle.
#AIWW dredging includes upland placement of material every few cycles.

Of the 43% of material managed by RSM principles, 43% (4.3 million CY) is placed on beaches (Figure 13). NAV projects at Morehead City, Manteo, AIWW, Masonboro Inlet, and Wilmington Harbor have beach-quality sand and all beach-quality material is beneficially used on adjacent beaches for a total annual value of $11 million to the following communities: Fort Macon/Town of Atlantic Beach (Morehead City Harbor); Pea Island (Manteo); Emerald Isle, Onslow Beach, North Topsail, Topsail, Carolina Beach, Holden Beach, Ocean Isle (AIWW); Wrightsville Beach and Masonboro Island (Masonboro Inlet); Bald Head Island, and Oak Island (Wilmington Harbor). Beach placement is the least-cost placement option for these projects, providing value to the federal government while providing shore protection and habitat benefits to adjacent property owners at no additional expense to the adjacent property owners.

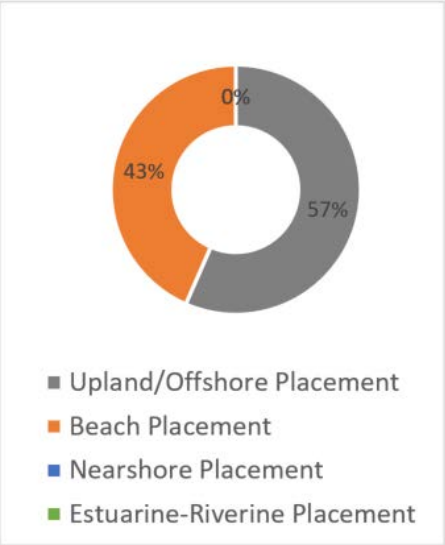


Figure 13. Distribution of placement by category for material dredged from SAW NAV projects.

For several FRM projects, inlets are used as borrow sources for beach-quality sand but these borrow sources are currently under review under the Coastal Barrier Resources Act (CBRA). These projects include Wrightsville Beach (Masonboro Inlet), Carolina Beach (Carolina Beach Inlet), and Ocean Isle (Shallotte Inlet). The inlets provide the least- cost source for beach-quality sand and dredging helps to maintain the channel for safe navigation and recreational use.

Opportunities for Action

The majority of dredged material in the Wilmington District consists of sand, silt, mud, and clay that is not suitable for beach placement. The State of North Carolina does not have nearshore placement provisions that allow for or provide criteria for placement of material with higher fine material content than beach-quality material. An opportunity for a research proposal could include an analysis of non-beach-quality material in key project areas to determine the volume and value of sediment that could be placed beneficially if the state's percent-fines regulations were modified or exempted. The proposal could include stakeholder meetings with state regulators and local sponsors. The Mobile District executes several RSM strategies for placing similar material which includes: open water placement, TLP, and wetland creation. Open water and TLP are two strategies that keep sediment in the active system; save available capacity in upland and offshore placement areas; and are typically the least-cost placement options. Wetland creation projects can support healthy ecosystems and provide significant placement capacity. These strategies, as well as other potential opportunities such as filling of relict dredge holes and coastal and wetland habitat restoration projects, could be explored by the Wilmington District.

4.1.2 Manteo (Shallowbag) Bay, Rollinson, and Silver Lake Harbor Navigation Projects

Summary

SAW manages the Manteo (Shallowbag) Bay, Rollinson, and Silver Lake Harbor NAV projects in an economically and environmentally efficient manner. SAW places approximately 200,000 CY of beach-quality dredged material from Manteo (Shallowbag) Bay on beach and nearshore areas of Pea Island, a National Wildlife Refuge managed by the U. S. Fish and Wildlife Service every five years for a total annual value of $0.3 million to the Pea Island National Wildlife Refuge at no additional cost (Figure 14) to the Federal Government.

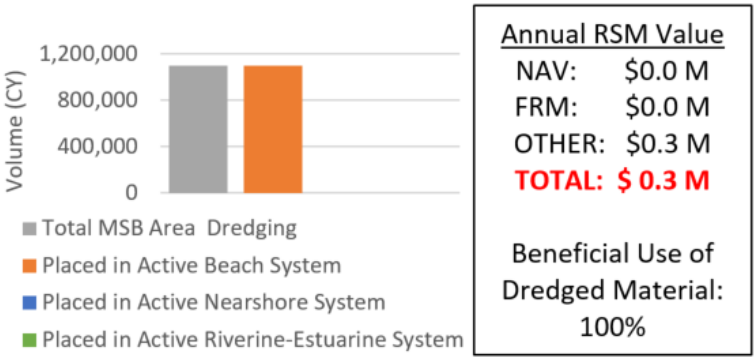


Figure 14. Average volume of sediment dredged from the Manteo (Shallowbag) Bay NAV project per dredge cycle (standard dredge cycle: 5 years). Total annual RSM value is $0.3 million.

An additional 900,000 CY of material is dredged every four to five years from channels at Manteo (Shallowbag) Bay, Rollinson, and Silver Lake Harbor and is strategically placed in upland placement areas to support environmental habitat for birds. The Outer Banks of North Carolina is an important nesting and migratory corridor for birds and management of dredged material is designed to support the environment and regional bird populations.

Introduction

The Manteo (Shallowbag) Bay, Rollinson Channel, and Silver Lake Harbor NAV projects are located along the Outer Banks in North Carolina (Figure 15). Rollinson project, which consists of Hatteras Ferry Channel and Rollinson Channel, is located near the Town of Hatteras, and Silver Lake Harbor project, which consists of Bigfoot Slough, Teaches Hole, and Silver Lake Harbor, is located on the southwest end of Ocracoke Island. The Manteo (Shallowbag) Bay project provides a 14-foot channel from the Atlantic Ocean through Oregon Inlet and to the Marc Basnight Bridge which was opened in 2019. The new Basnight Bridge includes seven 300-foot navigation spans which allow for the natural migration of the channel and significantly reduces dredging requirements near the

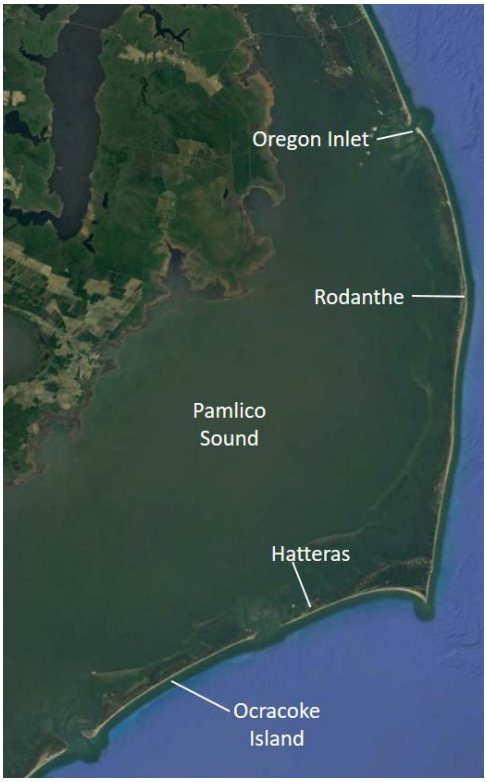


Figure 15. Map illustrating areas of interest near the Federal NAV projects from Oregon Inlet to Ocracoke Inlet.

bridge. The Manteo interior channels from the Basnight Bridge to Wanchese Harbor provides a 12-foot navigation channel.

The Rollinson and Silver Lake shallow draft projects are utilized by the North Carolina State Ferry Division to support navigation access to communities on Hatteras and Ocracoke Islands. The Rollinson Channel is 12 feet deep and 100 feet wide from Pamlico Sound to Hatteras Island, while Hatteras Ferry Channel from Hatteras Island to Hatteras Inlet is 10 feet deep and 100 feet wide. Silver Lake Harbor project provides access to Ocracoke Island. Bigfoot Slough and Teaches Hole channels are 12 feet deep with width of 150 feet, and Silver Lake harbor entrance channel is only 60 feet wide.

Beach-quality Material Placement Strategies

A summary of beach-quality sand placement strategies and total project costs is provided in Figure 16 and Table 8. Approximately 200,000 CY of beach-quality sand is dredged every five years from the Manteo (Shallowbag) Bay Channel and is placed on the beach at Pea Island (RSM 1). This placement strategy provides $0.3 million of annual shoreline protection value to Pea Island. An additional 600,000 CY is dredged from the interior channels of Manteo (Shallowbag) Bay and is placed in upland placement areas designed to support environmental habitat for local and migratory birds.

The Rollinson project at Hatteras Island and Silver Lake Harbor project at Ocracoke Island are maintained every five years. The projects at Hatteras and Ocracoke Islands dredge approximately 200,000 CY and 100,000 CY; all material is placed in upland placement areas designed to support local and migratory birds.

All dredged material from the five navigation projects are managed by RSM placement strategies.

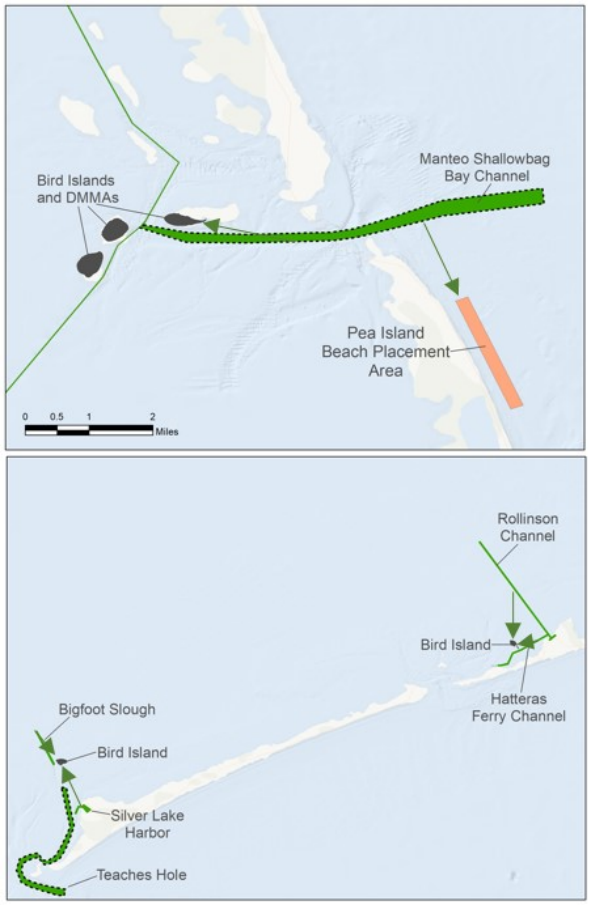


Figure 16. Map of Manteo (Shallowbag) Bay (top) and Rollinson and Silver Lake Harbor projects (bottom) dredged material placement strategies. Strategies are highlighted in Table 7.

Note: Dashed channel indicates channel location is not fixed.

Table 7. Summary of Costs and Value of Beach-quality Dredged Material at Manteo (Shallowbag) Bay, Rollinson Channel, Hatteras Ferry Channel, Bigfoot Slough, and Silver Lake Harbor Projects.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Ocean Bar to Nearshore	5	$9	200,000	$0.2	$2.0	$4.0	$0.8
	Potential RSM 1 OTHER Benefit	5	$10	150,000			$1.5	$0.3
							Total RSM 1 Value:	**$0.3**
RSM 2	Interior Manteo (Shallowbag) Bay Channels to Bird Islands (confined/unconfined upland)	4	$6	600,000	$0.3	$0.8	$4.7	$1.2
RSM 3	Hatteras Ferry & Rollinson to Bird Islands	5	$9	200,000	$0.1	$0.4	$2.3	$0.5
RSM 4	Bigfoot Slough to Bird Islands	5	$6	100,000	$0.1	$0.7	$1.4	$0.3

*Nearshore placement at -14 ft contour.

RSM 1 benefit was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from a typical borrow source.

4.1.3 Morehead City Harbor Navigation Project

Summary

SAW manages the Morehead City NAV project by placing approx.-imately 1.1 million CY of beach-quality dredged material every three years on beaches at Fort Macon State Park and the Town of Atlantic Beach for a total annual value of $2.8 million to the town and State of North Carolina at no additional expense to the Federal Government (Figure 17).

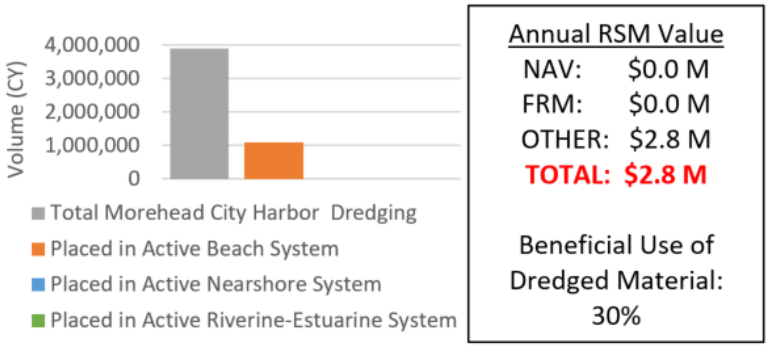


Figure 17. Average volume of sediment dredged from the Morehead City Harbor NAV project per dredge cycle (standard dredge cycle: 1-4 years). Total annual RSM value is $2.8 million.

Additional material from the same reaches is placed in a nearshore placement area and/or ODMDS during years two and three of the dredging cycle. The nearshore placement site is not a nearshore berm, but rather a placement site outside of the surf zone. If the material were placed in the active littoral system, an additional $6 million in annual value could potentially be attributed to the project for shore protection benefits provided to the Town of Atlantic Beach and Fort Macon State Park. Beneficial use placement in the littoral zone helps to maintain the ebb tide delta complex and also saves capacity at the ODMDS and nearshore placement sites.

Introduction

The Morehead City Harbor NAV project is located in Carteret County, NC (Figure 18). The federal navigation channel originates offshore and connects to Morehead City through Beaufort Inlet. The National Park Service manages Shackleford Banks, Cape Lookout, and other coastal islands as part of the Cape Lookout National Seashore. RSM placement options include nearshore placement at Shackleford Banks and beach and nearshore placement at Fort Macon State Park and Atlantic Beach. The Port of Morehead City is the second largest importer of natural rubber in the United States and a leading exporter of phosphate.

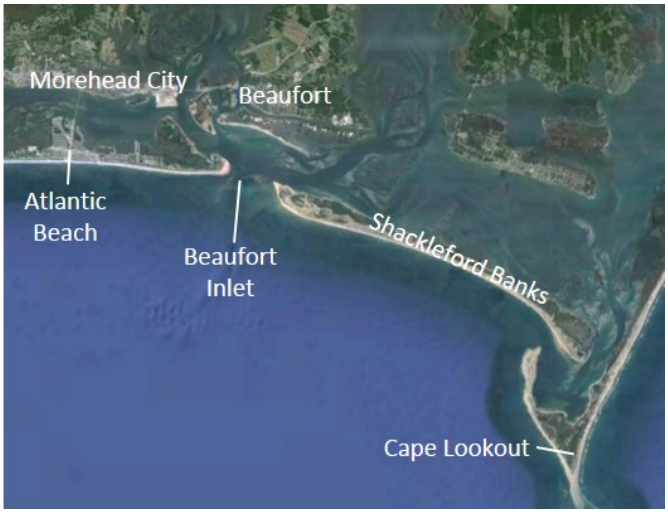


Figure 18. Map illustrating areas of interest near the Federal NAV project at Morehead City.

Due to an inconclusive Section 111 (Section 111 of the Rivers and Harbors Act of 1968, as amended, Shore Damage Prevention or Mitigation Caused by Federal Navigation Projects) study for the Morehead City Harbor project, the local sponsors cover the additional costs above the least-cost alternative (offshore placement) for placement of beach-quality sediments on the downdrift beaches along eastern Bogue Banks in Carteret County, NC through Section 933 of the Water Resources Development Act 1986 (Section 933). Section 933 allows the local sponsor(s) to contribute additional non-federal funds for the increased cost of beach nourishment as opposed to the least-cost dredged material placement option. There is a federally authorized CSRM project, Bogue Banks, near the federal navigation channel, however it has yet to receive federal appropriations.

Beach-quality Material Placement Strategies

A summary of beach-quality sand placement strategies and total project costs for Morehead City Harbor is provided in Figure 19 and Table 8. Presently, placement of harbor sediments is governed by the Morehead City Harbor Dredged Material Management Plan (DMMP), which includes entrance channel maintenance dredging with placement either on the downdrift beaches or within a nearshore placement area. The DMMP recommends placement along Bogue Banks once every three years, and placement in the offshore and nearshore placement areas two out of every three years. As part of managing the Morehead City Harbor channel, SAW coordinated with the National Park Service (NPS) to discuss placement options near or on Shackleford Banks, but NPS has refused any efforts to allow placement of material on or along its shoreline.

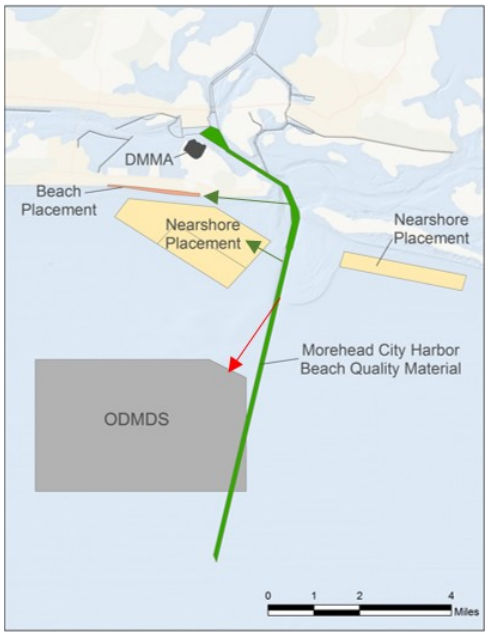


Figure 19. Map of Morehead City Harbor beach quality material placement strategies. Strategies are highlighted in Table 8.

Approximately 1.1 million CY of beach-quality sand is dredged and placed on the beach at Fort Macon State Park and the Town of Atlantic Beach every three years (RSM 1). This placement strategy provides $2.8 million of annual shoreline protection value to Fort Macon and Atlantic Beach.

During years two and three of dredging the same high shoaling area, the material is placed in nearshore placement areas east and west of the channel (RSM/NAV 1a). If nearshore conditions are not safe for placement, a limited amount of material (no more than 25% of the contract amount) can be placed in the ODMDS, which contains a cell for beach-quality material cell that serves as a sand holding area for beneficial re-use of the sand by USACE or other local communities. The potential annual value of this placement strategy is estimated at $6 million assuming all material is placed in the active littoral system. Success in implementing nearshore placement at Morehead City has been limited as contractors have been reluctant to bid on nearshore placement contracts. The nearshore placement area starts

approximately 1,000 feet from the beach and dredged material is typically placed outside of the active littoral system.

Table 8. Summary of Costs and Value of Beach-quality Dredged Material for Morehead City Harbor Project.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	South Range C; Range B; Cutoff; Range A to Beach	3	$8	1,100,000	$0.3	$3.0	$12.1	$4.0
	RSM 1 OTHER Benefit	3	$10	825,000			$8.3	$2.8
							Total RSM Strategy 1 Value:	**$2.8**
*RSM/ NAV 1a	South Range C; Range B; Cutoff; Range A to Nearshore/ODMDS	1.5	$9	1,200,000	$0.3	$3.0	$14.1	$9.4
	Potential RSM 1a OTHER Benefit	1.5	$10	900,000			$9.0	$6.0
							Total Potential RSM Strategy 1a Value:	$6.0

*RSM/NAV 1a conducted during the second and third year of a three year cycle with material placed on the beach every third year. Interval of 1.5 years to accurately depict annualized project cost.
RSM 1 OTHER benefit was estimated based on the volume of sand placed on the beach from RSM 1, 1a (assuming 25% loss during placement) times the cost per CY from a typical borrow source.

Other Material Placement Strategies

SAW manages approximately 1.6 M CY of additional dredged material from Morehead City Harbor that is not suitable for beach placement under current state regulations (Table 9). The dredged material is placed at upland and offshore placement areas based on proximity to the dredging sites and capacity of the placement areas.

Table 9. Summary of Costs and Value of Other Dredge Material for Traditional and RSM Projects at Morehead City Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1a	Northwest Leg; West Leg (1 & 2); East Leg; North Range C to ODMDS	4	$8	500,000	$0.2	$0.4	$4.6	$1.2
NAV 1b	Northwest Leg; West Leg (1 & 2); East Leg; North Range C to Brandt Island DMMA	4	$4	800,000	$0.2	$0.5	$3.9	$1.0
NAV 2	Range A (Seaward of Station 110+00) to ODMDS	5	$5	300,000	$0.2	$0.5	$2.2	$0.5

Opportunities for Action

SAW is currently placing approximately 1.2 M CY of beach-quality material in a nearshore placement site two out of every three years. If the material were placed in the active littoral system, an estimated $6 million in annual shoreline protection benefits to state and local government could be realized at no additional expense. Opportunities could be explored to create or enhance coastal and wetland habitats.

4.1.4 Atlantic Intracoastal Waterway Navigation Project in the Wilmington District

Summary

SAW manages the AIWW project in an economically efficient manner. Sediment that is dredged from areas where tidal inlets intersect the AIWW is placed on adjacent beaches as the least-cost alternative and provides $1.1 million in annual benefit to the adjacent beaches at no additional cost to the Federal Government. SAW dredges approximately 300,000 CY of material annually and places all materal on adjacent beaches for a total annual value of $1.1 million to non-federal beaches (Figure 20).

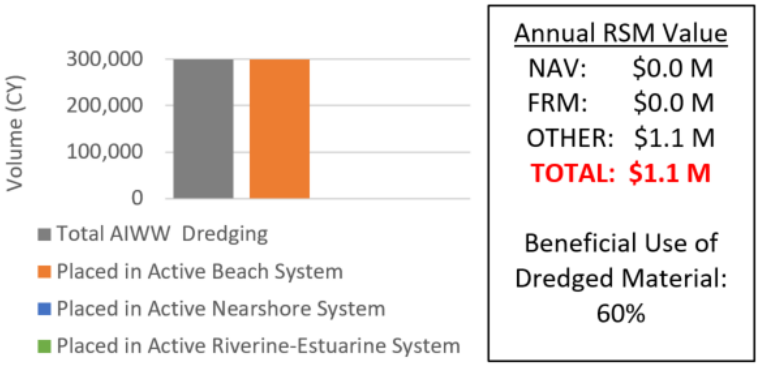


Figure 20. Average volume of sediment dredged from the Atlantic Intracoastal Waterway (AIWW) per dredge cycle (standard dredge cycle: 2 years). Total annual RSM value is $1.1 million.

The $1.1 million in annual value is split among six areas crossing the AIWW that, on average, are dredged every two years: Bogue, Brown's Inlet, New River, Topsail Beach Inlet, Carolina Beach Inlet, Lockwoods Folly Inlet, and Shallotte Inlet.

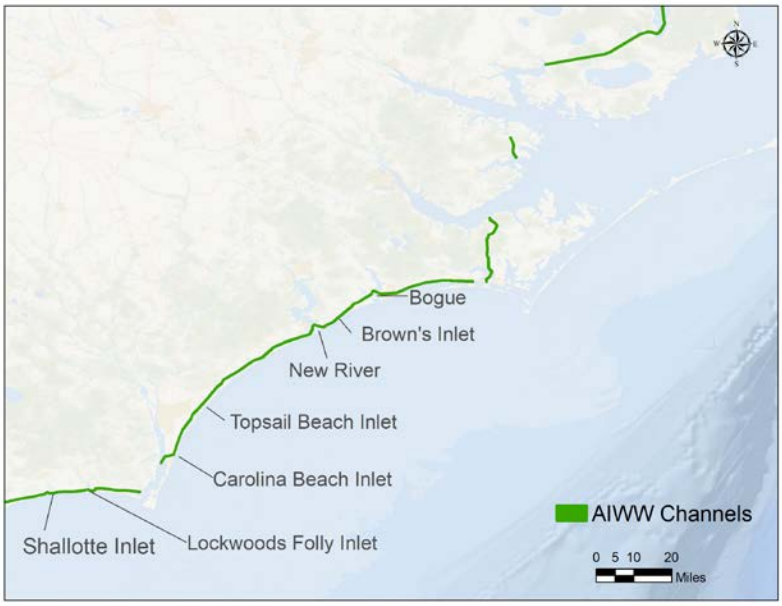


Figure 21. Map illustrating locations of beneficial use of dredged material from the federal AIWW NAV project in North Carolina.

Introduction

The AIWW in the Wilmington District is located in coastal North Carolina and is a 300-mile discontinuous 12-foot project connected by deeper draft projects from the Virginia – North Carolina border to the North Carolina – South Carolina border (Figure 21). The North Carolina portion of the AIWW is credited with generating over 4,000 jobs, $257 million in annual sales in the state, and $21.4 and 35.6 million in state and federal taxes, respectively.

Beach-quality Material Placement Strategies

A summary of beach-quality sand placement locations and total project costs is provided in Figure 21 and Table 10. Approximately 300,000 CY of material is dredged from the AIWW in North Carolina annually, and all of the dredged material is beach-quality sand that is beneficially placed on adjacent non-federal beaches. The annual cost of the AIWW NAV project is estimated at $4.4 million and provides $1.1 million in annual shore protection benefits to adjacent beaches. Beach-quality sand is located at seven AIWW crossings: Shallotte Inlet, Lockwoods Folly Inlet, Carolina Beach Inlet, Topsail Inlet, Bogue Inlet, New River Inlet, and Brown's Inlet (Figure 21 and Table 11).

Table 10. Summary of Costs and Value of Beach-quality Dredge Material for Traditional and RSM Projects on the AIWW in the Wilmington District.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV/RSM 1	AIWW to Beach/Upland	2	$7	300,000	$0.3	$2.0	$4.4	$3.3
	RSM 1 OTHER Benefit	2	$10	225,000			$2.3	$1.1
							Total RSM Strategy 1 Value:	**$1.1**

NAV/RSM 1 OTHER benefit estimated based on the volume of sand placed on the beach from NAV/RSM 1 (assuming 25% loss during placement) times the cost per CY from a typical borrow source.

Table 11. Summary Information for Beneficial Use Projects on the AIWW in the Wilmington District.

AIWW Crossing	Beach Placement Area	Interval (Yr)	Average Dredge Quantity (CY)	Beach Placement Length (ft)
Shallotte Inlet	Ocean Isle Beach	3	100,000	1,000
Lockwoods Folly Inlet	Holden Beach/Oak Island	3	100,000	1,000
Carolina Beach Inlet	Carolina Beach (Freeman Park)	3	100,000	1,000
New Topsail Inlet	Topsail Beach	3	100,000	1,000
Bogue Inlet	Emerald Isle beach	3	100,000	1,000
New River Inlet	North Topsail Beach	3	100,000	1,000
Brown's Inlet	Onslow Beach	3	100,000	1,000

Opportunities for Action

Approximately 100,000 CY of material is dredged annually from the AIWW that is placed in upland placement sites. Potential opportunities to conserve upland placement capacity and keep sediment in the system could include more beach placement, TLP, or island creation in the back barrier estuarine system adjacent to project channels.

4.1.5 Masonboro Inlet Navigation Project and Wrightsville Beach Coastal Storm Risk Management Project

Summary

SAW manages the Masonboro Inlet NAV project and Wrightsville Beach CSRM projects in an economically and environmentally efficient manner. SAW places approximately 800,000 cubic yards (CY) of beach-quality dredged material from Masonboro Inlet onto Wrightsville Beach. The use of Masonboro Inlet as the borrow source for Wrightsville Beach and Masonboro Island provides $1.7 million in annual benefits to the Federal Government (Figure 22).

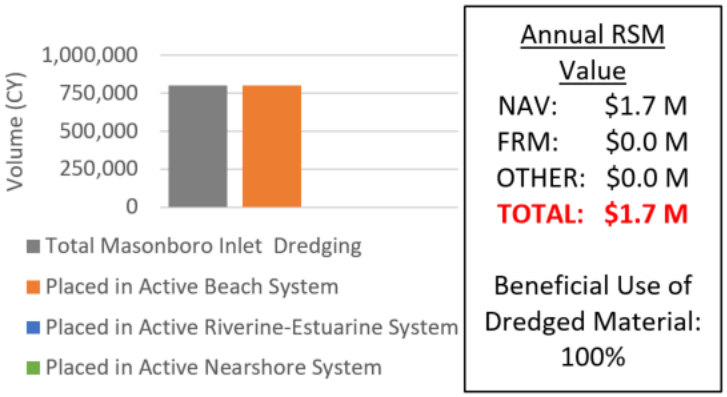


Figure 22. Average volume of sediment dredged from the Masonboro Inlet NAV project per dredge cycle (standard dredge cycle: 4 years). Total annual RSM value is $1.7 million.

The $1.7 million in annual value was based on the estimated cost of maintenance and advance maintenance of Masonboro Inlet assuming 800,000 CY of material was not dredged for the Wrightsville Beach CSRM. Considering both the NAV and FRM projects are maintained through one contract, an estimate $2.0 M in additional value was estimated based on the assumed cost for mobilizing a second dredge if the projects were managed separately. The total cost for maintaining the Masonboro Inlet channel, Wrightsville Beach, and Masonboro Island is $10.4 million/year.

Introduction

The Masonboro Inlet and Wrightsville Beach projects are located in New Hanover County, NC (Figure 23). The Masonboro Inlet federal navigation channel originates offshore and connects to the Atlantic Intracoastal Waterway (AIWW) between Wrightsville Beach and Masonboro Island. Wrightsville Beach is a narrow barrier island with four miles of sandy beach facing the Atlantic Ocean. The Wrightsville Beach project was initially completed in 1965 and reauthorized in 1986. The project covers 2.7 miles of shoreline and includes a berm and dune features. Masonboro Island is an undeveloped island only accessible by boat that is approximately eight miles in length and is part of the North Carolina National Estuarine Research Reserve and the North Carolina State Natural Area.

Figure 23. Map illustrating areas of interest near the Federal NAV project at Masonboro Inlet and CSRM project at Wrightsville Beach.

Beach-quality Material Placement Strategies

A summary of beach-quality sand placement strategies and total project costs is provided in Figure 24 and Table 12. Approximately 800,000 CY of beach-quality sand is dredged every four years from Masonboro Inlet and placed on Wrightsville Beach (RSM 1) for a total combined project cost of $2.6 million/year. Placement of material on Masonboro Island has been conducted in conjunction with the Wrightsville Beach project in the past, but has not been executed since 2010. The dredging strategy provides $1.7 million of annual maintenance value to the NAV program and also serves as the cheapest borrow source for beach-quality sand. In addition, the coordinated projects minimize mobilization costs and reduce USACE labor costs (e.g., permitting, plans and specs, surveys).

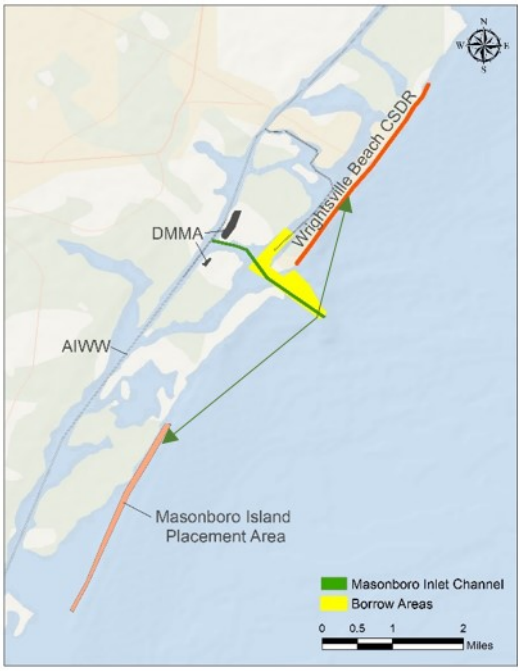


Figure 24. Map of Masonboro Inlet beach quality material placement strategies. Strategies are highlighted in Table 12.

Table 12. Summary of Costs and Value of Beach-quality Dredge Material for RSM Projects at Masonboro Inlet.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	*Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Masonboro Inlet to Wrightsville Beach CSRM	4	$9	800,000	$0.2	$3.0	$10.4	$2.6
	RSM 1 NAV Benefit A	4	$6	800,000			$4.8	$1.2
	RSM 1 NAV Benefit B	4				2.0	2.0	0.5
							Total RSM Strategy 1 Value:	**$1.7**

RSM 1 NAV Benefit A estimated based on the volume of sand removed from the channel times the estimated cost per CY for removal of 100% of the material and NAV Benefit B is the savings associated with combining NAV and FRM projects to eliminate a mobilization to dredge the NAV channel.

Opportunities for Action

SAW beneficially uses all material from Masonboro Inlet.

4.1.6 Carolina Beach and Kure Beach Coastal Storm Risk Management Projects

Summary

SAW manages the Carolina Beach and Kure Beach CSRM projects in an economically and environmentally efficient manner. SAW places approximately 1 million cubic yards (CY) of beach-quality sand on the Carolina Beach CSRM project and 650,000 CY of beach-quality sand on the Kure Beach CSRM project every three years to maintain adequate shore protection.

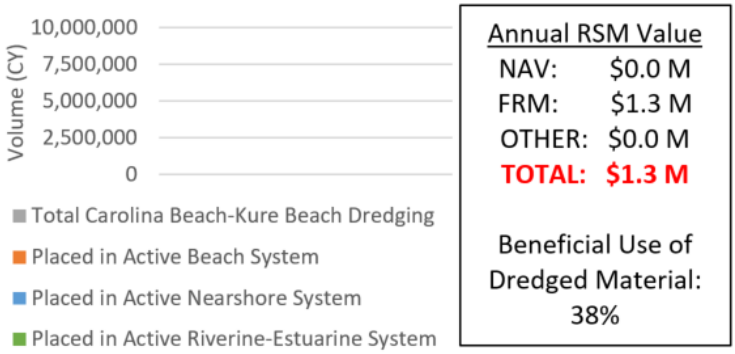


Figure 25. Dredge volumes for FRM projects limited to NAV projects. Total annual RSM value for Carolina Beach & Kure Beach projects is $1.3 million.

Sand for the projects is dredged from Carolina Beach Inlet and an offshore source with approximately 60% of the material coming from Carolina Beach Inlet. Sand from the inlet is a better value than sand from an offshore source based on unit costs of $4/CY and $9/CY, respectively. The estimated value for utilizing the inlet borrow source relative to an offshore borrow source is $1.3 million annually (Figure 25).

Introduction

The Carolina Beach and Kure Beach projects are located in New Hanover County between the Cape Fear River and Atlantic Ocean (Figure 26). The projects are buffered by Carolina Beach Inlet to the north and Zeke's Island Coastal Reserve to the south. The Carolina and Kure Beach projects span 2.7 and 3.4 miles, respectively, and include berm and dune features. Recreational activities at Carolina and Kure beaches include the beach and fishing piers as well as the North Carolina Aquarium at Fort Fisher and the Fort Fisher State Historic Site and Civil War Museum.

Figure 26. Map illustrating areas of interest near the federal FRM projects at Carolina Beach and Kure Beach.

Beach-quality Material Placement Strategies

A summary of sand placement strategies and total project costs is provided in Figure 27 and Table 13. Approximately 1 million CY of beach-quality sand is dredged every three years from Carolina Beach Inlet and is placed on Carolina Beach at an estimated cost of $5/CY and annual project cost of $2.4 million (RSM 1). The value of this strategy relative to using a traditional offshore borrow source is approximately $1.3 million per year.

The Kure Beach project only utilizes sand from an offshore borrow site at an estimated cost of $9/CY and an annual project cost of $2.7 million (CSRM 2). Use of the inlet as a sand source would not be economically efficient due to the long distance between the inlet and Kure Beach.

Opportunities for Action

SAW currently beneficially uses all available sand for the Carolina Beach and Kure Beach projects.

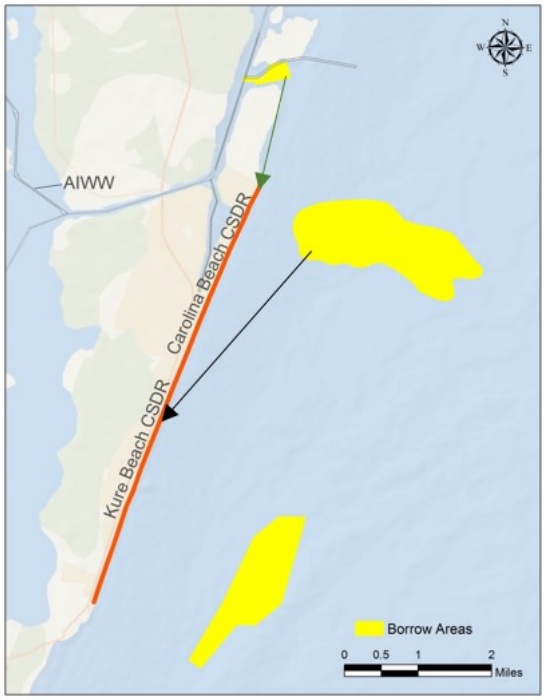


Figure 27. Map of Carolina Beach and Kure Beach beach quality material placement strategies. Strategies are highlighted in Table 13.

Table 13. Summary of Costs and Value of Beach-quality Dredged Material for Projects at Carolina Beach and Kure Beach.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
CSRM 1	Offshore to Carolina Beach	3	$9	900,000	$0.2	$2.0	$11.2	$3.7
RSM 1	Inlet to Carolina Beach	3	$5	900,000	$0.2	$2.0	$7.2	$2.4
							Total RSM Strategy 1 Value:	**$1.3**
CSRM 2	Offshore to Kure Beach SPP	3	$9	650,000	$0.2	$1.5	$7.5	$2.5

The value for RSM 1 was calculated by subtracting the annualized project cost of CSRM 1 from RSM 1.

4.1.7 Wilmington Harbor

Summary

SAW manages the Wilmington Harbor NAV project in an economically efficient manner. SAW dredges approximately 1.0 million CY of beach-quality material every two years and places it on beaches at Bald Head Island or Oak Island for a total annual value of $3.8 million to the non-federal beaches at no additional cost to the Federal Government (Figure 28).

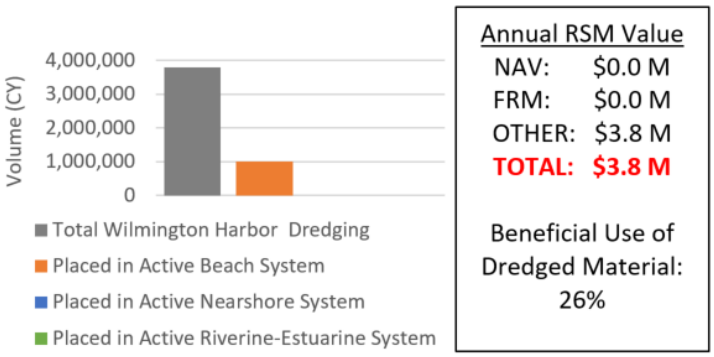


Figure 28. Average volume of sediment dredged from the Wilmington Harbor NAV project per dredge cycle (standard dredge cycle: 1-2 years). Total annual RSM value is $3.8 million.

An additional 2.8 million CY is dredged from other reaches of Wilmington Harbor and placed at established DMMAs or ODMDSs presenting a potential RSM opportunity.

Introduction

The Wilmington Harbor NAV project is located on the Cape Fear River in Brunswick and New Hanover Counties, NC (Figure 29). The project is approximately 38 miles in length and begins at the outer ocean bar and extends to the City of Wilmington. The Port of Wilmington moved roughly 3.5 million tons and over $6 billion in commerce in 2010. The Port is owned and operated by the North Carolina State Ports Authority and offers terminal facilities for bulk, breakbulk, and container operations.

Figure 29. Map illustrating areas of interest near the federal NAV project at Wilmington Harbor.

Beach-quality Material Placement Strategies

A summary of beach-quality sand placement strategies and total project costs is provided in Figure 30 and Table 14. Approximately 1.0 million CY of beach-quality sand is dredged every two years and is placed on the beach at Bald Head Island or Oak Island (RSM 1). Per the established sand management plan, 1/3 of the material is placed on Oak Island, and 2/3 of the material is placed on Bald Head Island. This placement strategy costs approximately $8/CY for a total annual project cost of $6.2 million. The value of placing the beach-quality sand at Bald Head Island and Oak Island is estimated at $3.8 million annually based on the estimated shore protection benefits.

Other Material Placement Strategies

SAW manages approximately 2.8 million CY of additional dredged material that is not suitable for beach placement under current state regulations (Table 15). The dredged material is placed at upland and offshore placement areas based on proximity to the dredging sites and capacity of the placement sites. Material from Baldhead Shoal Reach 3 is placed at the ODMDS at an estimated $4/CY (NAV 1), material from the Middle Cape Fear River is placed at the ODMDS or DMMAs at an estimated cost of $8/CY (NAV 2), and material from the Anchorage Basin and other up river channels is placed at Eagle Island (DMMA) at an estimated cost of $3/CY (NAV 3).

Figure 30. Map of Wilmington Harbor beach quality material placement strategies. Strategies are highlighted in Table 14.

Table 14. Summary of Costs and Value of Beach-quality Dredged Material for Wilmington Harbor Project.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Baldhead Shoal Reaches 1 & 2, Smith Island to Bald Head or Oak Island Beach	2	$8	1,000,000	$0.3	$4.0	$12.3	$6.2
	RSM 1 OTHER Benefit	2	$10	750,000			$7.5	$3.8
							Total RSM Strategy 1 Value:	**$3.8**

RSM 1 OTHER benefit was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from a typical borrow source.

Table 15. Summary of Costs and Value of Other Dredged Material for Wilmington Harbor Project.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Baldhead Shoal Reach 3 to ODMDS	1	$4	800,000	$0.2	$1.0	$4.4	$4.4
NAV 2	Various Middle Cape Fear River Channels ODMDS or River Disposal Islands	2	$8	800,000	$0.3	$1.5	$8.2	$4.1
NAV 3	Anchorage Basin, Between Channel, Fourth East Jetty Channel to Eagle Island (Confined Upland)	1	$3	1,200,000	$0.2	$0.9	$4.7	$4.7

Opportunities for Action

A significant amount of material is dredged from the Wilmington Harbor project that is not suitable for beach placement. This material, predominantly located in the Inner Channel, which may be utilized for environmental benefits, is currently placed in a DMMA at a cost of $3-8/CY. Thin-layer placement of dredge material in shallow, lower energy areas of rivers, estuaries, and marshes is a beneficial use gaining interest within the coastal management community that may provide beneficial use opportunities at Wilmington Harbor. Environmental benefits include promotion of submerged aquatic vegetation (SAV) habitat and restoring marsh elevations, especially in light of sea level rise. Other potential beneficial uses of dredge material in the project area could include filling of relict dredge holes and island habitat creation.

4.1.8 Ocean Isle Coastal Storm Risk Management Project

Summary

SAW manages the Ocean Isle CSRM project in an economically and environmentally efficient manner. SAW dredges approximately 500,000 CY of beach-quality material every three years from Shallotte Inlet and places it on the Ocean Isle Beach CSRM project. While there is no defined RSM value, use of sand from the inlet is consistent with RSM principles of keeping sediment within the active sediment system and is the cheapest source of beach-quality sand for the project (Figure 31).

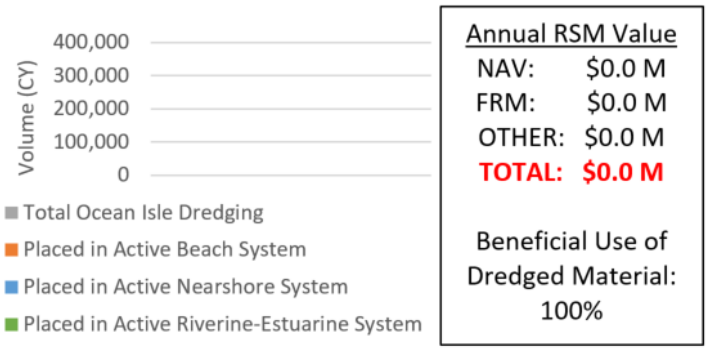


Figure 31. Dredge volumes for FRM projects limited to NAV sources.

**Ocean Isle uses the adjacent Shallotte Inlet as a borrow source which utilizes sediment in the active system. While not a federal NAV channel, dredging of the inlet supports safe navigation and recreation.*

Introduction

The Ocean Isle Beach project is located in Brunswick County, NC midway between Myrtle Beach, SC and Wilmington, NC. Ocean Isle Beach is between the Atlantic Ocean and Atlantic Intracoastal Waterway and is buffered on the east by Shallotte Inlet and to the west by Tubbs Inlet (Figure 32). The Town of Ocean Isle Beach was incorporated in 1959 and offers seven miles of sandy beach. Shallotte Inlet is a popular recreational channel that is marked by the U.S. Coast Guard.

Figure 32. Map illustrating areas of interest near the federal FRM project at Ocean Isle Beach.

Beach-quality Material Placement Strategies

A summary of beach-quality sand placement strategies and total project costs is provided in Figure 33 and Table 16. Approximately 500,000 CY of beach-quality sand is dredged from Shallotte Inlet every four years and placed on the beach at Ocean Isle Beach (RSM 1). This placement strategy costs approximately $8/CY for a total annual project cost of $1.5 million. The use of Shallotte Inlet as a borrow source is the cheapest option for beach-quality material and is consistent with RSM principles. In addition, the project eliminates all local navigation maintenance costs including dredging, mobilization costs, and other labor costs (e.g., permitting, plans and specs, surveys). This is an excellent example of a federal project providing local navigation value beyond the calculated benefits of the CSRM project.

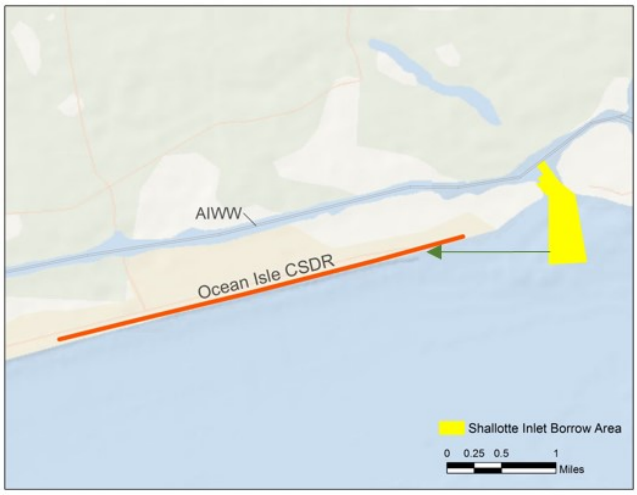


Figure 33. Map of Ocean Isle beach quality material placement strategy. Strategy is highlighted in Table 16.

Opportunities for Action

SAW currently beneficially uses all available sand for the Ocean Isle Beach project.

Table 16. Summary of Costs and Value for CSRM Project at Ocean Isle.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Shallotte Inlet to Ocean Isle Beach	4	$8	500,000	$0.3	$1.7	$6.0	$1.5

4.2 Charleston District (SAC)

The RSM Optimization Update analyzed eight projects in the Charleston District including five NAV projects and three FRM projects (Figure 34).

4.2.1 Summary of Navigation and Flood Risk Management Projects

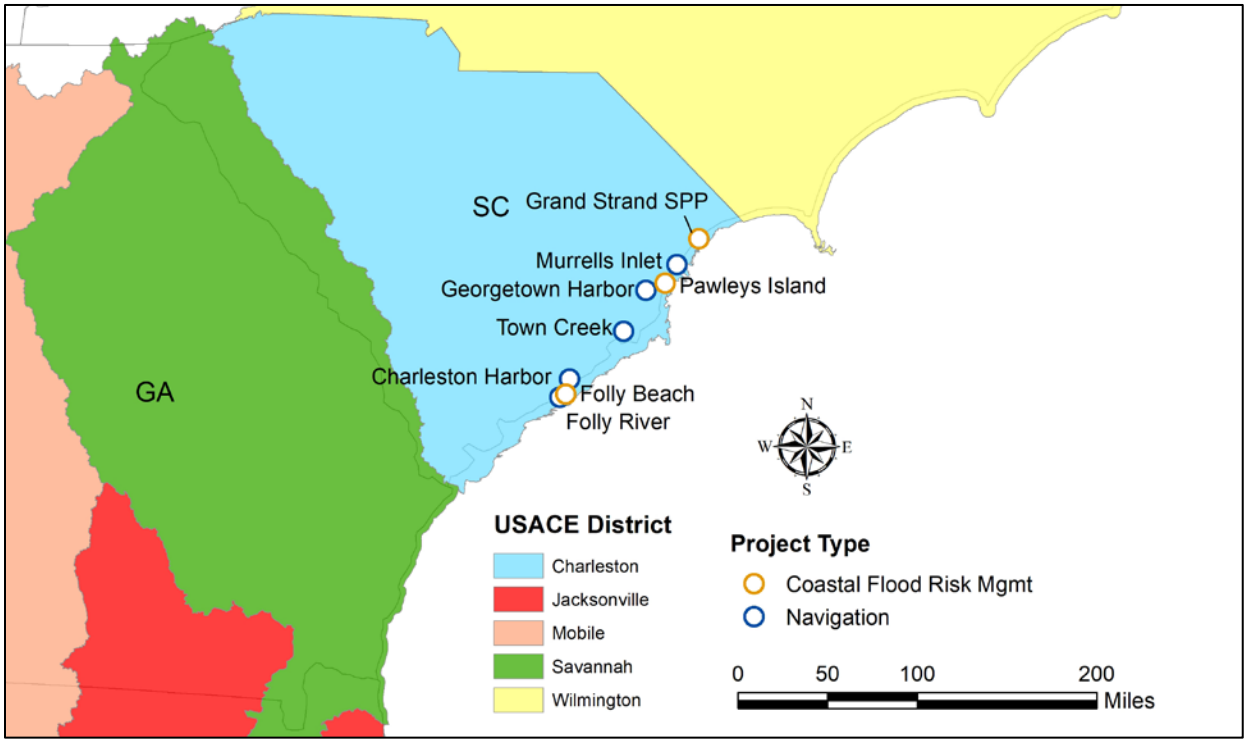


Figure 34. Map of Charleston District projects reviewed under the 2020 SAD RSM Optimization Update. Note: the AIWW is not included in the map.

Overview

NAV and FRM projects managed by the Charleston District were analyzed for economic and environmental efficiencies related to placement and beneficial use of dredged material. Implementation of RSM principles provides an estimated $44.5 million in total annual value to the Charleston District (Figure 35). an additional $3.4 million in value was identified at Charleston Harbor and the AIWW. Based on data from NAV projects in the Charleston District, an estimated 10.1 million CY is dredged per dredge cycle (9.3 million CY is passively diverted, suspended, or

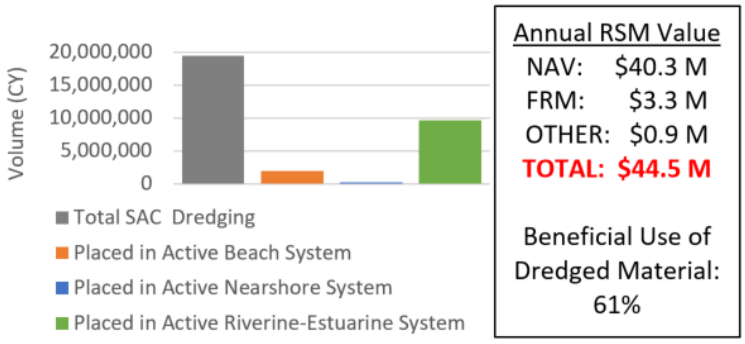


Figure 35. Average volume of sediment dredged from SAC NAV projects per standard project dredge cycles. Total annual RSM value is $44.5 million.

retained for a total of 19.4 million CY of managed dredged material) and 61% of the material is managed by RSM principles.

RSM Value and Sediment Placement

Of the Charleston District NAV projects, Murrells Inlet, Town Creek, and Folly River all beneficially place 100% of the projects' dredged material (Table 17). Approximately 83% of all SAC dredged/managed sediment volume is associated with Charleston Harbor channels, which provides 84% of all Charleston District's RSM value ($37.2 million). The two next highest dredge volume projects are the Folly River and AIWW, which remove 1.4 million CY and 1.1 million CY of dredged material, respectively, from project channels per dredge cycle for a total annual value of $5.1 million.

Table 17. Total Dredge Volume and Value of RSM Implemented Charleston District NAV-FRM Projects.

Project	*Total Dredge Volume (CY)	% Managed Using RSM Strategies	Annual RSM Value ($ M)
SAC Total	**19,400,000**	**61%**	**$44.5**
Grand Strand SPP			
Murrells Inlet	600,000	100%	$1.1
Town Creek	300,000	100%	$1.1
AIWW Projects	1,100,000	22%	$0.0
Charleston Harbor	16,000,000	58%	$37.2
Folly River-Folly Beach	1,400,000	100%	$5.1

*Total dredge volume calculated as the sum of all material dredged from NAV projects per dredge cycle.

Of the 61% of material that is managed using RSM principles in SAC, 10% (2.0 million CY) is placed on beaches, 1% (0.2 million CY) is placed in nearshore environments, and 50% (9.7 million CY) is maintained in estuarine-riverine environments (Figure 36). The Charleston Harbor, Town Creek, and AIWW projects utilize estuarine-riverine placement opportunities. For example, the Charleston Harbor project reduces 9.3 million CY of shoaling from the Cooper River Re-diversion Project canal and St. Stephen Powerhouse which supports Navigation, Hydropower, Flood Risk Management, Fish and Wildlife, and Recreation missions. The Santee River was dammed in the 1940s to provide electricity and flood control, and as a result, the increased flow caused the character of the harbor to change from a vertically well-mixed condition to a more stratified condition and significantly increased sedimentation into the Cooper River. The CRRP acts to restore the natural flow of water to the Santee River and returns the Charleston Harbor to a well-mixed salinity condition making it sustainable from a budget perspective.

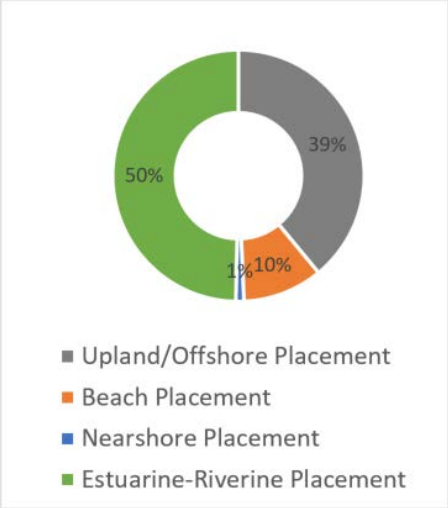


Figure 36. Distribution of placement by category for material dredged from SAC NAV projects.

NAV projects at Murrells Inlet and Folly River have beach-quality sand and all beach-quality material is beneficially used on adjacent beaches for a total annual value of $6.2 million to Georgetown County and Huntington Beach State Park (Murrells Inlet), and Charleston County (Folly River/Folly Beach). In 2017, Murrells inlet material was placed on Garden City Beach and Huntington Island State Park to protect infrastructure and create sea turtle habitat. In addition, 72,000 CY from Murrells Inlet was also placed on Huntington Island State park to stabilize the terminus of the Murrells Inlet South Jetty, which had been exposed due to erosion and was in danger of further degradation and structural failure. The Folly River navigation channel and borrow site was the source of material for the 2018 Folly Beach post-hurricane constructions which also included placement on the county park and Bird Key (a bird sanctuary). Beach placement was the least-cost placement option for the projects, which provides value to the federal government and also provides shore protection and habitat benefits to adjacent property owners at no additional expense to the adjacent property owner.

Opportunities for Action

SAC is currently working to dredge parts of Charleston Harbor to 52 feet as part of the Charleston Harbor Post 45 Deepening Project. The project is in the Construction phase. RSM opportunities incorporated into the project include the use of Entrance Channel rock for the construction of eight reefs, adding to the South Carolina Department of Natural Resources reef, and construction of a perimeter berm for the ODMDS also providing hard bottom habitat and fish habitat. Sandy material from the Entrance Channel will be placed at the south jetty terminus on Morris Island to offset erosion. This material does not meet criteria for Coastal Storm Damage Management projects, so it cannot be used at Folly Beach. Lower Harbor material has been studied under Section 204 (Water Resources Development Act – Beneficial Uses of Dredged Material) and is planned to be placed on Crab Bank, a bird sanctuary. The potential future use of O&M material from Lower Harbor or Shem Creek for marsh enhancement was identified in the Section 204 report as dependent upon the high ground placement first.

SAC is assessing the opportunity to bypass material adjacent to the Charleston Harbor north jetty to the nearshore area of Morris Island (downdrift of the south jetty) to reduce migration of material into the Entrance Channel from the north and potentially benefitting the Folly Beach CSRM project via littoral transport to the south. Additionally, SAC is collecting data to determine if new work construction of the most seaward reaches of the Entrance Channel contains sand. If the material can be beneficially used, SAC will place the material in a specific area of the ODMDS for future use. Other RSM opportunities being considered in SAC include placement of Folly River Entrance Channel material in the nearshore of Folly Beach.

RSM opportunities for O&M material, such as marsh enhancement and TLP will continue to be considered in the future to increase efficiencies and protect cultural and environmental resources, as well as infrastructure.

4.2.2 Grand Strand (North Myrtle Beach, Myrtle Beach, Surfside/Garden City Beach) and Pawleys Island Coastal Storm Risk Management Projects

Summary

SAC maintains the Grand Strand SPP by placing approximately 1.9 million CY of beach-quality sand along 25 miles of shoreline every eight years. Sand placed on the project is provided from four offshore borrow sources that contain over 70 million CY of beach-quality sand.

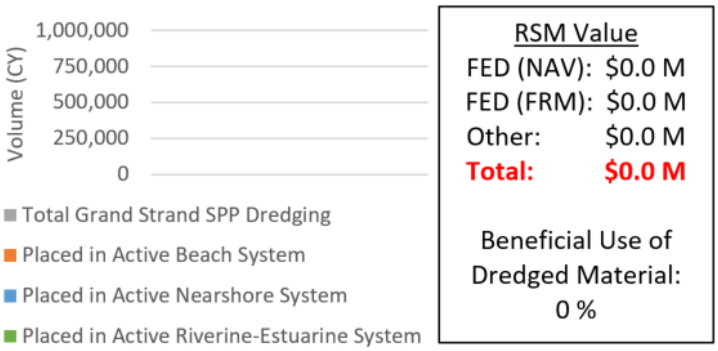


Figure 37. The Grand Strand and Pawleys Island SPPs are not located adjacent to any NAV projects that are routinely dredged and could provide beneficial use material. Dredge volumes for FRM projects limited to NAV sources. Murrells Inlet NAV project is located several miles south of the SPP but is currently not an economically viable source of sand.

The Grand Strand SPP is not located near any regularly maintained NAV projects and as a result, beneficial use of dredge material is limited (Figure 37). Beach-quality sand from Murrells Inlet could be utilized to supplement sand requirements at the shore protection at Garden City Beach, but funding for the NAV project is limited and irregular and volumes are not sufficient to support the entire project.

The Pawleys Island CSRM project is approximately 7,500 feet in length and sand to support the project will be from an offshore borrow source. Initial construction is anticipated in 2020.

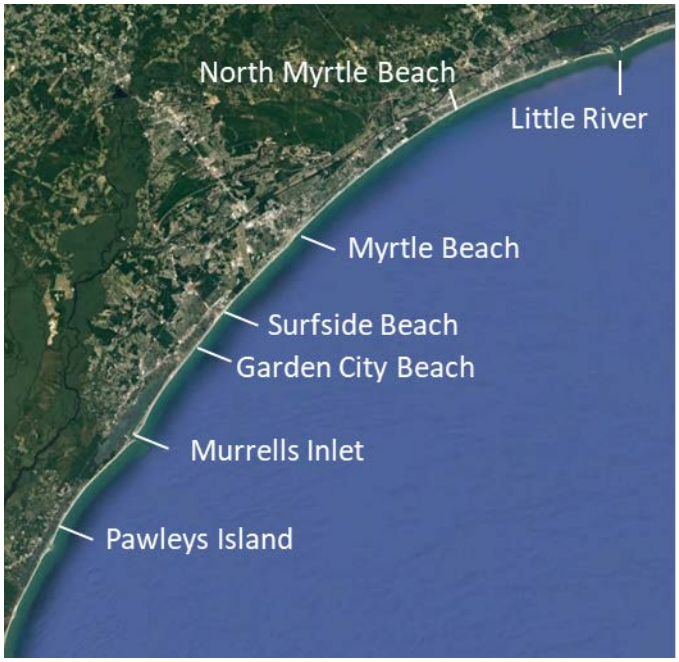


Figure 38. Map illustrating areas of interest near federal NAV and FRM projects in coastal northeast South Carolina. Grand Strand SPP: Reach 1-North Myrtle Beach, Reach 2-Myrtle Beach, Reach 3-Surfside/Garden City.

Introduction

The Grand Strand SPP is located along the coast of Horry County and a small portion of adjacent Georgetown County, SC (Figure 38). The project reduces the risk of coastal storm-induced damages to people and property along the Grand Strand. The timing and amount of material are dependent on the performance of the project versus the frequency and severity of the storms impacting the area. The project is approximately 25 miles long and consists of three separate reaches: Reach 1, North Myrtle Beach; Reach 2, Myrtle Beach; and Reach 3,

Garden City/Surfside Beach. The project was initially constructed in 1997 and most recently nourished in 2018 in conjunction with post Hurricane Florence Public Law 84-99 placement. Sand is provided from four offshore borrow sources.

The Pawleys Island CSRM project is anticipated to be constructed in 2020. The 7,500-foot project will include approximately 700,000 CY of fill for initial construction and will include four 9-year nourishment intervals and one 5-year nourishment interval over the 50-year life of the project.

Beach- and nearshore-quality material Placement Strategies

A summary of beach-quality sand placement strategies and total project costs is provided in Figure 39 and Table 18. Approximately 1.9 million CY of beach-quality sand is required every eight years to maintain the shoreline protection projects at North Myrtle Beach (Reach 1), Myrtle Beach (Reach 2), and Garden City/Surfside (Reach 3), respectively. Offshore sand sources at Little River (Reach 1), Cane North and South (Reach 2), and Surfside (Reach 3) contain over 70 million CY of beach-quality material to support project sand requirements.

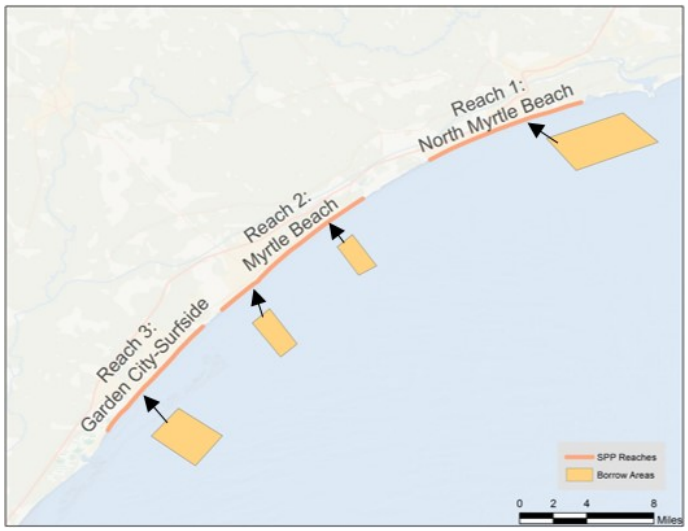


Figure 39. Map of Grand Strand SPP material placement strategies. Strategies are highlighted in Table 18.

The estimated cost of the combined projects is $42.2 million total and the annual cost is $5.3 million based on the most recent nourishment costs. The 1998, 2008, and 2018 projects included nourishment of all three reaches which minimized mobilization costs and increased economic efficiency. Cost per CY range from $18 to $20 with the greatest fill volumes located in Reach 2.

Table 18. Summary of Costs for Grand Strand and Pawleys Island SPP.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
MYRTLE BEACH								
SPP	Offshore Borrow to North Myrtle Beach	8	$18	490,000	$0.1	$1.6	$10.5	$1.3
SPP	Offshore Borrow to Myrtle Beach	8	$20	440,000	$0.3	$1.6	$23.9	$3.0
SPP	Offshore Borrow to Garden City Beach	8	$19	360,000	$0.1	$1.6	$8.5	$1.1
Total Grand Strand SPP Cost:							$43.0	$5.4
PAWLEYS ISLAND								
SPP	Offshore Borrow to Pawleys Island	$9	$13	900,000	$0.8	$3.5	$16.0	$1.8

Opportunities for Action

Economically efficient RSM opportunities were not identified for the Grand Strand SPP. Placing sand from the Murrells Inlet federal NAV project at the Garden City Beach (Reach 3) is an option to supplement the project, but the NAV project has limited funding, is on an irregular schedule, and volumes are not sufficient to support the entire project. The material from the Murrells Inlet project is generally placed along the non-federal beach in Georgetown County, Huntington Beach State Park, or the south jetty at Murrells Inlet.

4.2.3 Murrells Inlet Navigation Project

Summary

SAC manages the Murrells Inlet NAV project in an economically and environmentally efficient manner. SAC places approximately 600,000 CY of beach-quality dredged material every 14 years on adjacent non-federal beaches for a total value of $1.1 million annually (Figure 40).

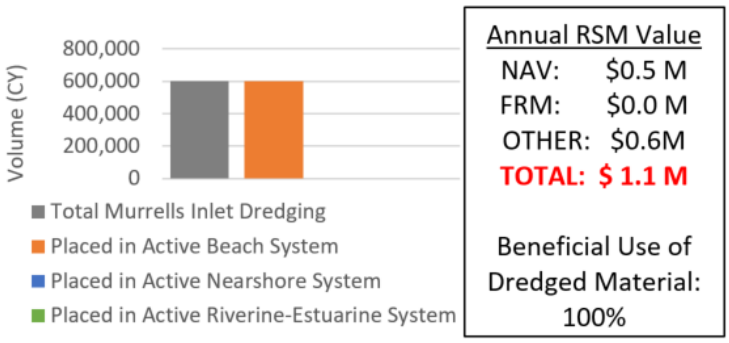


Figure 40. Average volume of sediment dredged from the Murrells Inlet NAV project per dredge cycle (standard dredge cycle: 14 years). Total annual RSM value is $1.1 million.

Material dredged from Murrells Inlet is placed north of the inlet at the non-federal Georgetown County beach at Garden City or south of the inlet at Huntington Beach State Park. Of the estimated $1.1 million in annual value, $0.5 million is attributed to the NAV program based on placement costs relative to the closest ODMDS, and $0.6 million is attributed to Georgetown County or the state park (based on the cost of sand from an offshore borrow source) at no cost to the Federal Government. The implemented RSM strategies provide habitat for birds and turtles, shore protection for adjacent beaches, and erosion control for the Murrells Inlet jetties.

Introduction

Murrells Inlet is located about 20 miles northeast of the City of Georgetown, SC and 13 miles southwest of the City of Myrtle Beach (Figure 41). The inlet is a natural tidal inlet which serves as an outlet for an estuarine area in the northern section of Georgetown County. The inlet is bordered on the south by Huntington Beach State Park and to the north by the unincorporated beach community of Garden City Beach.

Figure 41. Map illustrating Murrells Inlet NAV project and adjacent areas of interest.

Beach-quality Material Placement Strategies

A summary of beach-quality sand placement strategies and total project costs is provided in Figure 42 and Table 19. Approximately 600,000 CY of beach-quality sand is dredged from Murrells Inlet Entrance Channel every 14 years. The total

cost of placement at the Georgetown ODMDS is estimated at $13.9 million or $1.0 million annually (NAV 1), and the total cost of placement at adjacent beaches at Garden City or Huntington Beach State Park is $7.0 million or $0.5 million annually (RSM 1). Sand is also placed along the back side of the south jetty to protect the structure from erosion on an as-needed basis.

The value of the implemented RSM strategy relative to the traditional NAV strategy is $0.5 million annually. The estimated value of the placement strategy to beaches at Garden City or Huntington Beach State Park is estimated at $0.6 million annually assuming 75% of the dredged material is placed on the beach or south jetty at an estimated value of $19/CY based on the cost of sand from an offshore borrow source. Additional benefits include habitat for turtles and numerous bird species as well as erosion control for the Murrells Inlet jetties. Additional value could be realized if the material was placed at Reach 3 of the Grand Strand Shore Protection Project (SPP). Volumes are not sufficient to support the entire project and funding for the NAV project is limited and irregular.

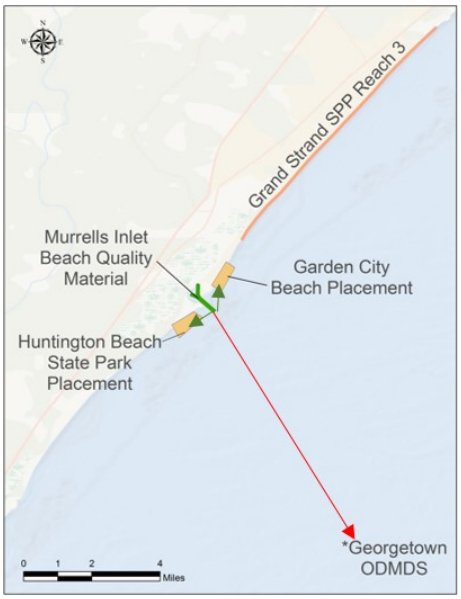


Figure 42. Map of Murrells Inlet material placement strategies. RSM strategies are highlighted in Table 19.

**Georgetown ODMDS is beyond the extent of the map.*

Table 19. Summary of Costs and Value of Beach-quality Dredge Material for Project at Murrells Inlet.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Murrells Inlet Entrance Channel to Georgetown ODMDS	14	$21	600,000	$0.3	$1.0	$13.9	$1.0
RSM 1	Murrells Inlet Entrance Channel to Garden City/Huntington Beach/South Jetty	14	$7	600,000	$0.3	$2.5	$7.0	$0.5
							RSM Strategy 1 Value:	**$0.5**
	RSM 1 OTHER Benefit	14	$19	450,000			$8.6	$0.6
							TOTAL COMBINED RSM Strategy 1 Value:	**$1.1**

RSM 1 OTHER Benefit was estimated based on the volume of sand placed on the beach (assuming 25% loss during placement) times the cost per CY from an offshore borrow source (Grand Strand SPP).

Placement at Garden City Beach is south of the federal SPP and does not provide direct benefits to FRM program.

Opportunities for Action

SAC is currently beneficially placing all material from the Murrells Inlet NAV project. Placing sand from Murrells Inlet federal NAV project at the Garden City Beach (Reach 3) was considered in the analysis. The sand could be used to address erosion hotspots and lengthen the interval between required maintenance events. Funding for the NAV project is limited and irregular and would require additional coordination between the projects to implement the RSM strategy.

4.2.4 Town Creek Federal Navigation Project

Summary

SAC manages the Town Creek NAV project in an economically and environmentally efficient manner. SAC places approximately 300,000 CY of dredged material adjacent to the project channel for a total annual value of $1.0 million annually to the NAV program (Figure 43).

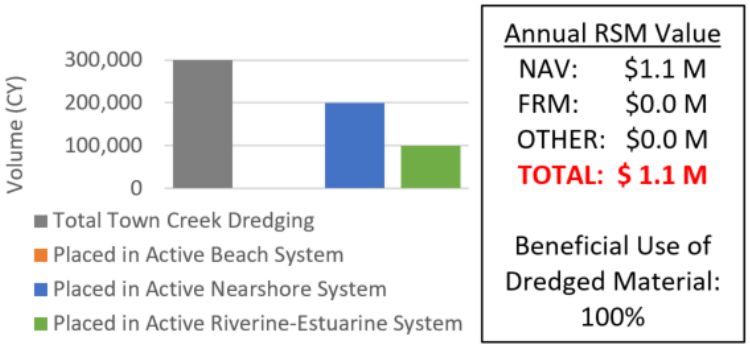


Figure 43. Average volume of sediment dredged from Town Creek NAV project per dredge cycle (standard dredge cycle: 5 years). Total annual RSM value is $1.1 million.

The SAW-owned dredge plant Merritt, a sidecaster dredge, is used to maintain the Town Creek channel. The $1.1 million annual value is based on the volume of sediment dredged from the Entrance and Inner Channel relative to traditional placement at the closest upland and ODMDS. Placement adjacent to the channel is consistent with RSM principles of maintaining sediment within the active sediment system. Sidecasting of dredged material from the Inner Channel is the only feasible placement option and is consistent with RSM principles of keeping sediment in the coastal system.

Introduction

Town Creek is located one mile southwest of McClellanville, SC (Figure 44). McClellanville, located on Jeremy Creek, is homeport to a large fleet of shrimp boats; the principal economic activity is commercial fishing. The project provides a ten-foot deep by 80-foot wide inner channel from the Atlantic Intracoastal Waterway (AIWW) to the mouth of Five Fathom Creek, a distance of 6.2 miles. Additionally, the project includes a 12-foot deep by 100-foot wide Entrance Channel across the ocean bar, a distance of 4.0 miles. The channel provides access to the open ocean for 30–35 commercial shrimp vessels that operate out of the area.

Figure 44. Map illustrating the Town Creek NAV project and adjacent areas of interest.

All Dredge Material Placement Strategies

A summary of dredging strategies and total project costs is provided in Figure 45 and Table 20. Approximately 200,000 CY of material is dredged from the Entrance Channel every five years for a total cost of $0.6 million or $0.1 million annually (RSM 1). If the same material was placed at the Georgetown ODMDS, the total annual project cost was estimated at $1.1 million (NAV 1) for an annual RSM value of $1.0 million per year to the NAV program.

The Inner Channel is dredged every five years for a total cost of $0.5 million or $0.1 million annually (RSM 2). The value of the project versus traditional placement at a DMMA is $0.1 million.

Opportunities for Action

All dredged material from the Town Creek NAV project is beneficially used.

Figure 45. Map of Town Creek dredge material placement strategies. Placement strategies are highlighted in Table 20. **Georgetown ODMDS is beyond the extent of the map. Label for reference only. See Georgetown Harbor Fact Sheet for location.*

Table 20. Summary of Costs and Value of Dredge Material for Project at Town Creek.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Town Creek Entrance/Clark Creek to Georgetown ODMDS	5	$21	200,000	$0.2	$1.0	$5.4	$1.1
RSM 1	Town Creek Entrance/Clark Creek to Open Water (sidecast)	5	NA	200,000	$0.2	NA	$0.6	$0.1
							RSM Strategy 1 Value:	**$1.0**
NAV 2	Town Creek Inner/Five Fathom Creek to DMMA	5	$8	100,000	$0.2	$0.3	$1.3	$0.2
*RSM 2	Town Creek Inner/Five Fathom Creek to Open Water	5	NA	100,000	$0.2	NA	$0.7	$0.1
							RSM Strategy 2 Value:	**$0.1**
							TOTAL COMBINED RSM Strategies 1 and 2 Value:	**$1.1**

RSM 1 value was calculated by subtracting the cost of NAV 1 from RSM 1.

#Value of RSM 2 relative to traditional project was not calculated. Comparable project at Jeremy Creek placing at a DMMA is $6/CY.

4.2.5 Atlantic Intracoastal Waterway (AIWW) Federal Navigation Project

Summary

SAC manages the AIWW NAV project from the North Carolina – South Carolina border to Port Royal Sound near Hilton Head, SC. Approximately 1.1 M CY of material is dredged every dredge cycle (Figure 46). In order to maintain project depth throughout the project, dredging of the entire project would be required every three years. Due to available funding and resources, SAC focuses dredging at hotspots and high shoaling areas, and for emergency support.

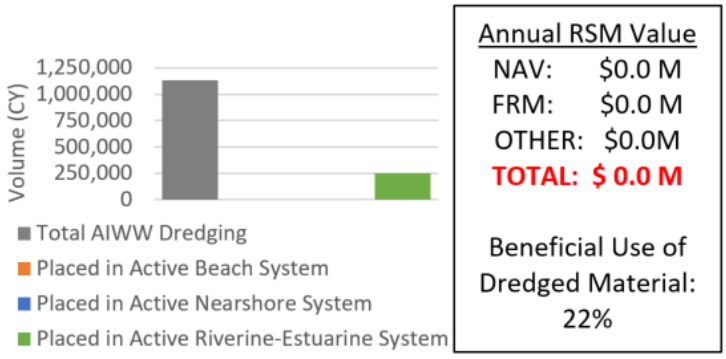


Figure 46. Average volume of sediment dredged from the AIWW NAV project per dredge cycle. Current dredging strategies focus on high shoaling areas and emergency support.

Currently, material from Dawhoo Reach is placed in open water which is consistent with RSM placement principles of keeping sediment in the active coastal system. Open water placement costs are comparable to other upland placement projects, so RSM value was not calculated. An RSM opportunity was identified for beach-quality material at Breach Inlet to be placed on non-federal beaches at Sullivan's Island. The cost of placement on the beach is more expensive than placement at a DMMA, but would provide overall net benefits $0.4 million from annual shore protection benefits to the adjacent non-federal beaches based on the cost of sand from an offshore borrow source. The strategy would also save capacity at adjacent DMMAs for non-beach-quality material. Considering the high cost of development and maintenance of DMMAs, all efforts to conserve DMMA capacity should be encouraged. Additional studies may be required to ensure material is not transported back into the channel or negatively impacts adjacent areas. In addition, RSM opportunities are being explored for marsh placement of material via TLP. Discussions with Cape Romain Wildlife Refuge, located along northeast Charleston County, are ongoing to further develop opportunities that may provide benefit.

Introduction

The AIWW is 235 miles long within the State of South Carolina. The Charleston District maintains 210 miles of the AIWW in South Carolina, from the North Carolina – South Carolina state line above Little River Inlet to Port Royal Sound near Hilton Head (Figure 47). Savannah District maintains the remaining 25 miles of the AIWW in South Carolina, from Port Royal Sound to the South Carolina – Georgia state line. Through its length in South Carolina, the AIWW consists of a system of naturally deep estuaries, rivers, and sounds that have been connected by a series of man-made land cuts to provide a continuous in-land navigation route.

For operation and maintenance purposes, Charleston District has divided the AIWW into three nearly equal reaches. Reach 1 starts near Little River Inlet at the North Carolina – South Carolina border and extends south for 62 miles to Winyah Bay near Georgetown. Reach 2 starts at Winyah Bay and extends south for 63.5 miles to Charleston Harbor. Reach 3 starts at Charleston Harbor and extends south for 84.5 miles to Port Royal Sound.

In order to maintain the authorized depth of 12 feet through the length of the AIWW in South Carolina, each reach would require full dredging every three years. Full dredging of Reach 1 was last completed in 2002, full dredging of Reach 2 was last completed in 2000, and full dredging of Reach 3 was last completed in 1997. Since that time, Charleston District has focused dredging at high shoaling areas and various hot spots throughout the AIWW in South Carolina and to support emergency needs. Recent AIWW dredging includes Reach 2 hotspots in 2018, Reach 3 hotspots in 2017, and Breach Inlet and Jeremy Creek in 2015.

Figure 47. Map illustrating locations of regularly dredged locations along the AIWW in the Charleston District. Project costs and RSM strategies are highlighted in Table 21.

All Dredge Material Placement Strategies

A summary of dredging strategies and total project costs is provided in Table 21. Approximately 1.1 M CY of material is dredged from the AIWW every dredge cycle for a total cost of $7.3 million. The Charleston District has focused on dredging AIWW hotspots as limited funding does not allow for maintaining the entire AIWW to project depth. An RSM opportunity for beneficial use of sediment was identified for beach-quality material from Breach Inlet, a tidal inlet located a couple of miles north of Charleston Harbor, to be placed at Sullivan's Island. Currently, the material is placed at a DMMA for $4/CY with an annual project cost of $0.9 million (NAV 1). The material could be placed on adjacent beaches at Sullivan's Island for $8/CY and provide an overall net value of $0.4 million in annual shore protection benefits at the non-federal beach (RSM 1).

The other regular AIWW dredging project locations include: Jeremy Creek, Limehouse Reach, Dawhoo Reach, and Ashepoo-Coosaw Cut. Material from Dawhoo Reach (RSM 2) is placed in open water which is consistent with RSM placement principles of keeping sediment in the system. Open water placement costs are comparable to other upland placement projects so RSM value was not calculated. All other projects place dredged material in adjacent DMMAs.

Table 21. Summary of Costs and Value of Dredge Material for Projects on the AIWW.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Breach Inlet to DMMA	3	$4	500,000	$0.4	$0.2	$2.6	$0.9
RSM 1	Breach Inlet to Sullivan's Island beach	3	$8	500,000	$0.4	$3.0	$7.4	$2.5
							Potential RSM Strategy 1 Value:	**$ (1.60)**
	Additional OTHER Benefit	3	$16	375,000			$6.0	$2.0
							TOTAL COMBINED POTENTIAL RSM Strategy 1 Value:	**$0.4**
RSM 2	Dawhoo Reach to Open Water	10	$4	250,000	$0.4	$0.2	$1.6	$0.2
NAV 2	Jeremy Creek to DMMA	6	$5	100,000	$0.4	$0.2	$1.1	$0.2
NAV 3	Limehouse Reach to DMMA	10	$6	30,000	$0.4	$0.2	$0.7	$0.1
NAV 4	Ashepoo-Coosaw Cut to DMMA	10	$3	250,000	$0.4	$0.2	$1.3	$0.1

RSM 1 value was calculated by subtracting the cost of NAV 1 from RSM 1.
RSM 1 and 1a OTHER Benefit was estimated based on the volume of sand placed on the beach (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

Opportunities for Action

The quality of dredge material for most of the SAC AIWW projects is either unknown or testing is in progress. Identification of material type is a great RSM research opportunity which will help to determine potential beneficial use placement options. Potential placement options may include open water or TLP, wetland or island habitat creation, or filling of relict dredge holes.

4.2.6 Charleston Harbor Federal Navigation Project

Summary

SAC manages the Charleston Harbor NAV project. Approximately 6.9 million CY of material is actively dredged from the project every dredge cycle and an additional 9.3 million CY of sediment is passively diverted, suspended or retained in the Santee River System by the Cooper River Rediversion Project at St. Stephen Power House on Lake Moultrie (Figure 48). The annual value of the CRRP to the NAV program is estimated at $37.2 million. An additional $3.0 million in annual value to the NAV program was identified for RSM placement of Entrance Channel dredge material relative to placement at the Charleston ODMDS. New work Post 45 Deepening volumes were not included in the total volume estimates but provide numerous beneficial uses.

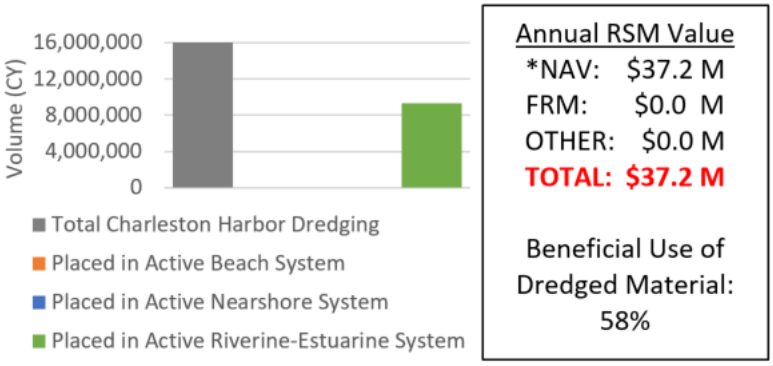


Figure 48. Average volume of sediment dredged from the Charleston Harbor NAV project per dredge cycle. Total annual RSM value is $37.2 million.

SAC is currently working to dredge parts of Charleston Harbor to 52 feet as part of the Charleston Harbor Post 45 Deepening Project. The project is in the Construction phase. RSM opportunities incorporated into the project include the use of Entrance Channel rock for the construction of eight reefs, adding to the South Carolina Department of Natural Resources Artificial Reef Program, and construction of the perimeter berm for the ODMDS which provides hard bottom and fish habitat. Sandy material from the Entrance Channel will be placed at the south jetty terminus on Morris Island to offset erosion that has occurred.

Introduction

The Charleston Harbor federal navigation channel is located in Charleston Harbor, SC, which lies approximately midway along the South Carolina coast (Figure 49). It is approximately 140 miles southwest of the entrance to Cape Fear River, North Carolina and 75 miles northeast of the Savannah River.

Figure 49. Map illustrating locations of interest related to the Charleston Harbor NAV project.

The current Charleston Harbor dimensions are described as follows: the project, as authorized and under construction, consists of Lower

Harbor Channel at 52 feet and Upper Harbor Channel of 48 feet (54 feet for the entrance channel) below mean low water (MLW) with two feet of advance maintenance and two feet of allowable overdepth for most of the harbor. The entrance to Charleston Harbor is flanked by a pair of rubble mound weir jetties 2,900 feet apart. Construction of the jetties was completed in 1895. The south jetty, which extends from Morris Island, is 19,100 feet in length. The north jetty, which extends from Sullivan's Island, is 15,400 feet in length. Since jetty construction was completed, Morris and Folly Islands, located downdrift, have experienced severe erosion due to the elimination of sediment bypassing around the harbor's previously expansive ebb tidal delta. Meanwhile, Sullivan's Island, located on the updrift side of the harbor jetties has accreted significantly.

The Entrance Channel Operations & Maintenance is dredged by a hopper dredge and the material is transported to the ODMDS. The reaches around the ocean bar require minimal maintenance due to naturally deep water. Maintenance dredging of the Lower Reaches below Shipyard River to the Entrance Channel (Lower Harbor) is done by mechanical (clamshell) dredge and the material is transported via scow to the ODMDS. A hydraulic pipeline dredge is used for maintenance dredging in the Upper Harbor of the Cooper River and the material is placed in the DMMA.

In 1942, the Santee River was dammed to provide hydroelectric power and flood control for the Santee Basin. A diversion canal was constructed from the Santee River to the headwaters of the Cooper River, where the hydropower facility was constructed. As a result, water flow and sedimentation into Charleston Harbor increased significantly. In 1985, USACE constructed the CRRP to redirect flows back to the Santee River and reduce sedimentation and dredging costs in Charleston Harbor. This is an excellent RSM element of the Charleston Harbor project because it addresses an important lesson learned in the nation's coastal management history. The damming and diversion of rivers that previously transported sediment to coasts has contributed to long-term beach erosion by reducing sediment supply.

New work construction of the Entrance Channel associated with the Charleston Harbor Deepening Project began in 2018 using cutter suction dredge, hopper, and excavator. Excavated rock is being used beneficially for creation of hard bottom habitat in the form of construction of eight reefs, adding to the South Carolina Department of Natural Resources reef, and construction of the perimeter berm for the ODMDS which also provides hard bottom habitat and fish habitat. Sandy material from the Entrance Channel will be placed at the south jetty terminus on Morris Island to offset erosion. The material does not meet current criteria for Coastal Storm Damage Reduction projects, so it cannot be used at Folly Beach. All other material will be placed in the ODMDS.

Lower Harbor material has been studied under Section 204 (Water Resources Development Act – Beneficial Uses of Dredged Material) and is planned to be placed on Crab Bank, a bird sanctuary, as the project progresses. An estimated 660,000 CY is anticipated to be the final placement volume for Crab Bank which will provide 28 acres of Brown Pelican Bird Nesting Habitat and increase the existing island size from 30 acres to 80 acres relative to Mean Lower Low Water (MLLW) based on surveys collected at the time of the study.

All Dredge Material Placement Strategies

A summary of dredging strategies and total project costs is provided in Figure 50 and Table 22. Approximately 9.3 million CY of sediment is passively diverted, suspended, or retained down the Santee River (natural flow before modifications to system was along the Santee River) via the CRRP that provides $37.2 million in annual value to the NAV program (RSM A).

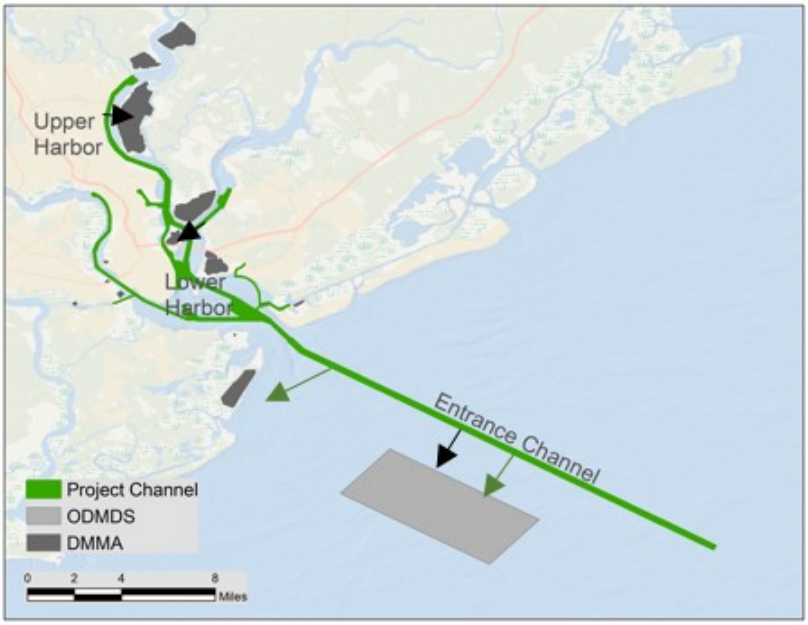


Figure 50. Map of Charleston Harbor material placement strategies. RSM strategies are highlighted in Table 22.

Approximately 1.6 million CY of material is dredged from the Entrance Channel and placed at the ODMDS every two years for a total price of $12.8 million or $6.4 million annually (NAV 1). An economically beneficial RSM project was identified in the Entrance Channel. Approximately 500,000 CY of the Entrance Channel material with high sand content can be placed in the nearshore that can provide an estimated $3.0 million in value (RSM 1) in shore protection benefits based on the cost of placing material in the nearshore from a traditional borrow area.

Approximately 1.8 million CY is dredged from the Lower Harbor that is placed in the ODMDS every year and a half at a project cost of $11 million (NAV 2). Other annual Operations & Maintenance dredging in the harbor include Joint Base Charleston that which places the material a DMMA at a project cost of $6.2 million (NAV 3) and Upper Harbor which places material in the Clouter Creek Disposal Area at a project cost of $5.4 million (NAV 4).

The Charleston Harbor Post 45 Deepening Project initiated construction in March 2018 and will include dredging of approximately 20 million CY of material and provides numerous opportunities for RSM and beneficial uses of dredged material. Approximately 6.1 million CY of limestone and other material from the Entrance Channel is being used to develop artificial reefs for both beneficial use (six reefs) and mitigation (two reefs) for a total project cost of $52 million (RSM 2). An additional RSM strategy for 14 million CY of dredged material from the Entrance Channel will be used to provide sediment to eroded areas along the south jetty in Charleston Harbor and Morris Island at an estimated project cost of $285 million (RSM 3).

Opportunities for Action

Portions of the Entrance Channel new work dredging at the most ocean-ward reaches are suspected to have high sand content. This material will be placed in a specific area of the ODMDS for future

investigation and potential use. SAC is also exploring options for sediment bypassing of material adjacent to the north jetty along Sullivan's Island to the nearshore area of Morris Island downdrift of the south jetty to reduce migration of sediment into the entrance channel, protect the south jetty terminus, and potentially benefit Folly Beach CSRM as littoral transport is to the south.

RSM opportunities for O&M material, such as marsh enhancement and TLP will continue to be considered in the future to increase efficiencies and protection of cultural and environmental resources as well as infrastructure. The potential future use of O&M material from Lower Harbor or Shem Creek for marsh enhancement was identified in the 204 report as dependent upon the high ground placement first. Lower Harbor material has been studied under Section 204 (Water Resources Development Act – Beneficial Uses of Dredged Material) and may be implemented for the placement of new work material on Crab Bank, a bird sanctuary as the project progresses. The potential future use of O&M material from the Lower Harbor or Shem Creek for marsh enhancement was identified in the 204 report as dependent upon the high ground priority placement.

Table 22. Summary of Costs and Value of Dredge Material for Project at Charleston Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($)	Mobilization ($)	Total Project Cost ($)	Annualized Project Cost ($)
RSM A	Cooper River to Santee River via St. Stephens Powerhouse	1	$4	9,300,000	$-	$-	$ 37.2	$37.2
							RSM Value Strategy 1:	**$37.2**
NAV 1	Entrance Channel to ODMDS	2	$7	1,600,000	$0.4	$1.2	$12.8	$6.4
RSM 1	Entrance Channel (inside jetty) to nearshore BUD	2	$9	500,000	$0.3	$0.3	$5.0	$2.5
	RSM 1 OTHER Benefit	2	$16	375,000			$6.0	$3.0
							POTENTIAL RSM Value Strategy 1:	**$3.0**
NAV 2	Lower Harbor to ODMDS	1.5	$5	1,800,000	$0.4	$1.6	$11.0	$7.3
NAV 3	Joint Base Charleston Channel to Yellowhouse Creek DA	1	$4	1,200,000	$0.4	$1.0	$6.2	$6.2
NAV 4	Upper Harbor to Clouter Creek DA	1	$3	1,400,000	$0.4	$0.7	$5.3	$5.3
NAV 5	Shem Creek to Morris Island DA	10	$6	200,000	$0.4	$0.3	$1.8	$0.2
NAV 6	Anchorage Basin to ODMDS	10	$5	500,000	$0.4	$0	$2.9	$0.3
RSM 2 (Post 45)	Entrance Channel to Artificial Reef @ ODMDS	single event	$8	6,100,000	$0.3	$2.7	$51.8	$51.8
RSM 3 (Post 45)	Entrance Channel to Reef/Sand @ Morris Island	single event	$18	14,000,000	$0.3	$31.8	$284.1	$284.1
*RSM 4 (Post 45)	Lower Harbor to Crab Bank BUD	single event		700,000				

RSM value was calculated by subtracting the cost of NAV project from the RSM project.

RSM A is the Cooper River Diversion which was built in the 1980s and reduces shoaling in Charleston Harbor by over 50%. Value calculated as sediment removed (9.3 million CY) x $4/CY (average placement cost) for total annual value of $37.6 million.

*Unable to release estimates.

BUD: Beneficial Use of Dredged Material.

4.2.7 Folly River Federal Navigation Project and Folly Beach Shore Protection Project

Summary

SAC manages the Folly River NAV project in an environmentally and economically efficient manner. Recent coordination between the Folly River and Folly Beach projects have resulted in execution of a new RSM strategy that maintains the Folly River project, provides sand for the Folly Beach SPP, and creates over $5 M in annual RSM value (Figure 51). All material dredged from the Folly River project is beneficially used. Of the total RSM annual value, $1.5 million is attributed to the NAV program (as a result of a cheaper placement option relative to offshore placement), $3.3 million is attributed to the FRM program, and $0.3 million is attributed to Charleston County for shore protection benefits at a county park.

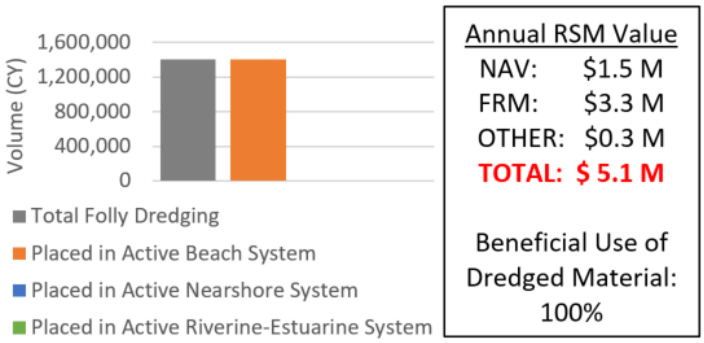


Figure 51. Average volume of sediment dredged from the Folly River NAV project per dredge cycle. Total annual RSM value is $5.1 million.

The Folly Beach SPP receives sand approximately every eight years from an offshore borrow area. Currently, beneficial use of dredged material from Folly River or Charleston Harbor is not an economically efficient source of sand for the project. Based on a Section 111 evaluation, the NAV project at Charleston Harbor is required to mitigate 57% of erosion impacts at the Folly Beach SPP, documenting linkages between the two projects and opportunities to explore RSM efficiencies.

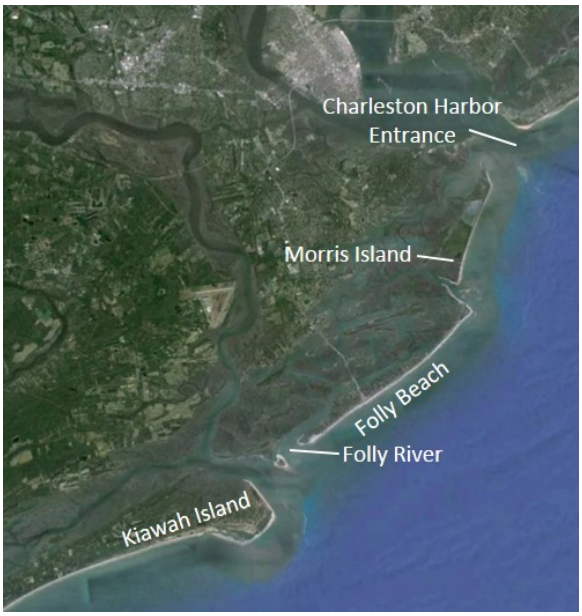


Figure 52. Map illustrating locations of interest related to the Folly Beach SPP and Folly River NAV project.

Introduction

The Folly River is located in Charleston County along the landward side of Folly Island approximately six miles south of the entrance to Charleston Harbor (Figure 52). The river originates in the tidal marshes at the north end of Folly Island and terminates at its junction with the Stono River. The Folly River project is approximately three miles in length. Folly River is typically maintained with a pipeline dredge and piped dredge material has historically been placed onto an area known as the Bird Key Stono Complex or, if

quality is adequate, Folly Beach County Park. Most recently, 1.2 million CY of beach-quality sand was placed on the Folly Beach SPP from the Folly River.

Folly Beach is located in Charleston County, approximately 12 miles south of the City of Charleston downtown area and 9 miles southwest of Sullivan's Island. The 6-mile long island reaches from the confluence of the Stono and Folly Rivers at the west end to Lighthouse Creek at the east end. Coastal storm damage reduction projects on Folly beach are primarily carried out to protect the economic resources located on Folly Island from erosion and storm events and to mitigate erosion impacts from Charleston Harbor jetties, with secondary benefits of providing additional beach and dune area for sea turtle nesting and providing habitat for the Wilson's plover and least tern.

All Dredge Material Placement Strategies

A summary of dredging strategies and total project costs is provided in Figure 53 and Table 23. The total value of implemented RSM strategies at Folly River is $5.1 million/year.

The Folly Beach SPP has been nourished with sand from an offshore borrow source every eight years for a total project cost of $26.5 million or $3.3 million annually. An RSM strategy to place beach-quality sand on Folly Beach from the Folly River channel and adjacent shoals was recently executed (RSM 1). The project placed 1.2 million CY of sand on Folly Beach for a total project cost of $16 million. The RSM strategy provides $4.4 million in annual value with $1.1 million attributable to the NAV program as beach placement is the cheapest placement alternative and $3.3 million attributed to the SPP.

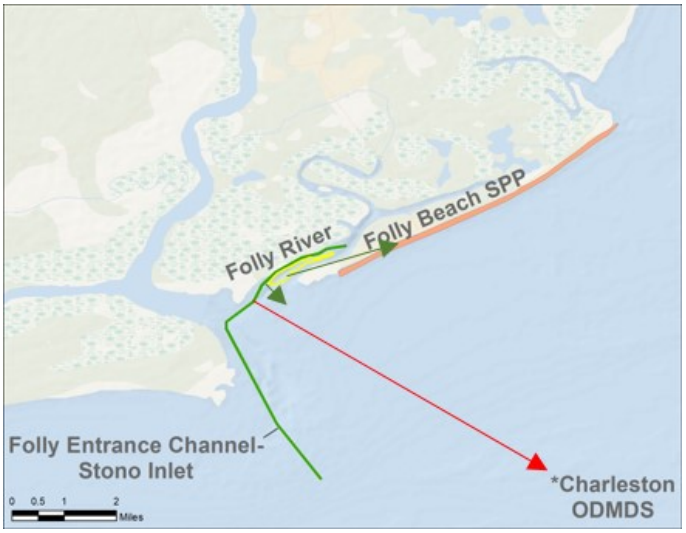


Figure 53. Map of Folly River and Folly Beach material placement strategies. RSM strategies are highlighted in Table 23. Sediment from Folly River channel and adjacent area (yellow polygon south of channel) recently placed on Folly Beach SPP. Arrows at Folly River-Stono Inlet indicate placement at the county park and Bird Key Stono Complex (shoal island west of Folly Island not on map).

**Charleston ODMDS is beyond the extent of the map.*

Approximately 200,000 CY of material is dredged from the Folly River that is placed at a Charleston County park for an annual cost of $200,000 (RSM 1a). Placement on the beach relative to offshore placement (NAV 2) provides $400,000 in annual savings to the NAV program and the sand placed on the beach provides approximately $300,000 in annual value to the park for a total RSM 1a project value of $700,000.

Opportunities for Action

All material from the Folly River NAV project is beneficially used. Considering the relatively high CY and mobilization cost for the adjacent SPP, additional opportunities should be explored to beneficially use material from the Charleston Harbor NAV project at the Folly Beach SPP. The available volume from Folly River is limited and could be used to supplement the project or address acute erosion hot spots.

Table 23. Summary of Costs and Value of Dredge Material for Projects at Folly River and Folly Beach.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($)	Mobilization ($)	Total Project Cost ($)	Annualized Project Cost ($)
SPP 1	Offshore Borrow to Folly Beach	8	$16	1,400,000	$0.8	$3.5	$26.5	$3.3
NAV 1	Folly River to ODMDS/DMMA	8	$20	1,200,000	$0.3	$0.8	$25.0	$3.1
						Combined traditional SPP and NAV project cost:	$51.5	$6.4
RSM 1	Folly River to Folly Beach	8	$10	1,200,000	$0.5	$3.5	$16.0	$2.0
							*** RSM Strategy 1 Total Value:**	**$4.4**
NAV 1a	Folly River to ODMDS	8	$20	200,000	$0.3	$0.8	$5.0	$0.6
RSM 1a	Folly River to County Park/Bird Key Stono	8	$8	200,000	$0.1	$0.2	$1.8	$0.2
							RSM Strategy 1a NAV Value:	**$0.4**
	RSM 1a OTHER Benefit	8	$16	150,000			$2.4	$0.3
							TOTAL COMBINED RSM Strategy 1a Value:	**$0.7**
							TOTAL COMBINED RSM Strategy 1 and 1a Value:	**$5.1**

*RSM value was calculated by subtracting the cost of NAV project from the RSM project. Total value of RSM 1 (4.4 M) calculated as $1.1 M to NAV based on difference in cost for NAV 1 and RSM 1 and additional value attributed to SPP ($3.3 M).

RSM 1a OTHER Benefit was estimated based on the volume of sand placed on the beach (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

4.3 Savannah District (SAS)

The RSM Optimization Update analyzed four projects within the Savannah District including three NAV projects and one FRM projects (Figure 54).

4.3.1 Summary of Navigation and Flood Risk Management Projects

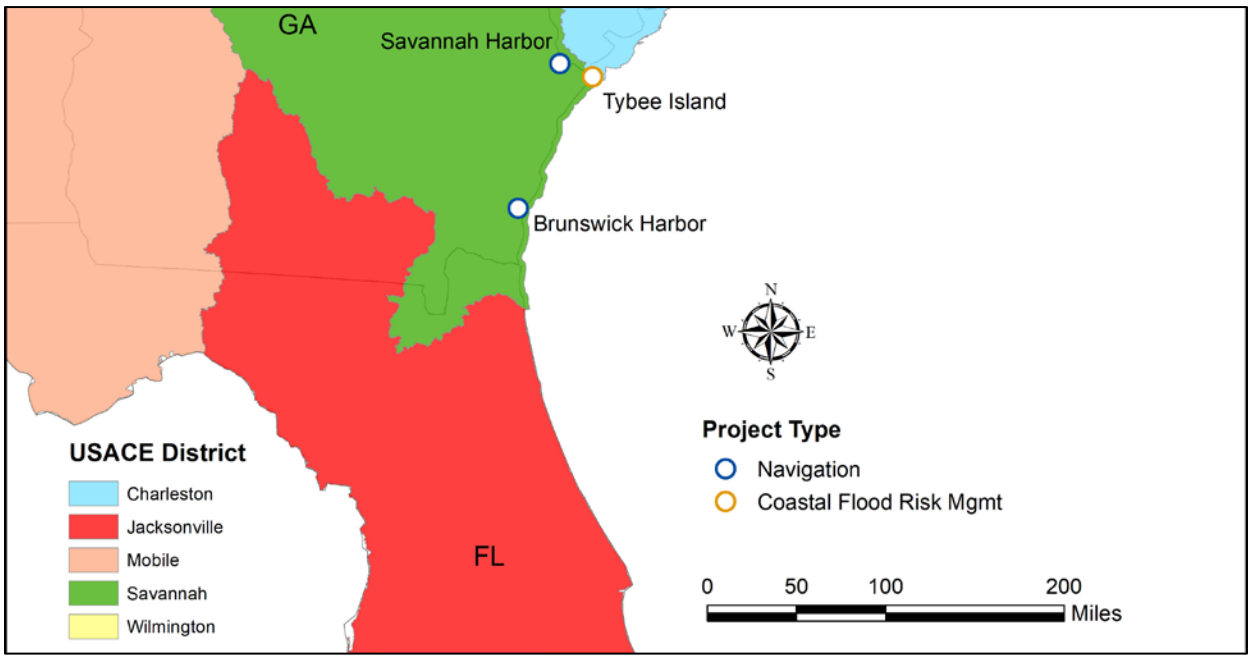


Figure 54. Map of Savannah District projects reviewed under the 2020 SAD RSM Optimization Update. Note: the AIWW is not included in the map.

Overview

NAV and FRM projects managed by the Savannah District were analyzed for economic and environmental efficiencies of placement and beneficial use of dredged material. Placement at Fort Pulaski, a Civil-War-era fort on the Savannah River managed by the National Park Service, and beneficial-use placement of AIWW dredged material provides $0.8 million in annual RSM value (Figure 55). The AIWW beneficial-use pilot projects identified economically efficient, environmentally acceptable, long-term dredged material placement strategies for AIWW dredged material in Georgia and beyond. Via advance maintenance opportunities, the Savannah District, South

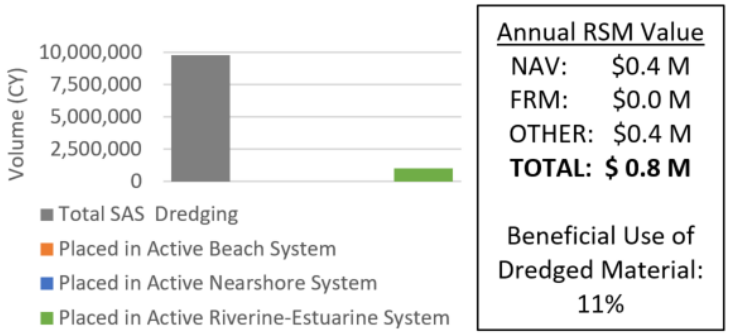


Figure 55. Average volume of sediment dredged from SAS NAV projects per standard project dredge cycles. Total annual RSM value is $0.8 million. One-time placement of sand at Fort Pulaski (Savannah Harbor) provided $2.0 million in shore protection benefits to the National Park Service. An identified RSM opportunity to place material from Savannah Harbor to Tybee Island nearshore could provide $1.1 million in annual value to the FRM program.

Atlantic Division, and RSM Regional Center of Expertise identified efficiencies at Kings Island Turning Basin that resulted in $3.5 million in annual savings to the NAV program and reduced impacts to port operations.

RSM Value and Sediment Placement

Based on data from three NAV projects in the Savannah District, an estimated 9.8 million CY is dredged per dredge cycle, with 10% of the dredged material managed using RSM principles. Of the two major Savannah District NAV projects, Savannah Harbor dredges approximately 7.1 million CY per dredge cycle and Brunswick Harbor dredges 1.8 million CY per dredge cycle (Table 24). Beneficial use of dredge material is limited to Savannah Harbor and the AIWW projects.

Table 24: Total Dredge Volume and Value of RSM Implemented Savannah District NAV-FRM Projects.

Project	*Total Dredge Volume (CY)	% Managed Using RSM Strategies	Annual RSM Value ($ M)
SAS Total	**9,800,000**	**11%**	**$0.8**
Savannah Harbor	7,100,000	4%	$0.4
Brunswick Harbor	1,800,000	0%	$ -
AIWW	900,000	89%	$0.4

*Total dredge volume calculated as the sum of all material dredged from NAV project per dredge cycle.

Of the 11% of material that is managed by RSM principles, all material is placed in estuarine-riverine environments (1.1 million CY) (Figure 56). Beneficial use in Savannah Harbor consists of dredging beach-quality sand from the Savannah River and placing it on the beach at Fort Pulaski. The project is irregular, but provides up to $2.0 million of shore protection value per placement opportunity to the National Park Service. Additional RSM value in Savannah Harbor is a result of altering dredging strategies in the upper harbor to limit maintenance dredging to once annually.

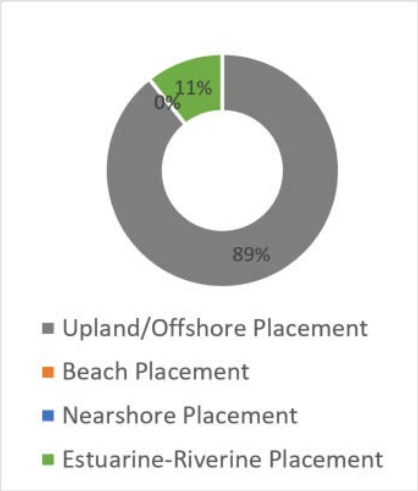


Figure 56. Distribution of placement by category for material dredged from SAS NAV projects.

In 2017, the Savannah District partnered with the RSM RCX, the Jacksonville District, Georgia Department of Nature Resources, Jekyll Island Authority, and The Nature Conservancy to develop beneficial use strategies for the AIWW and executed TLP and open water dispersal projects in the spring/summer of 2019. The TLP project was the first TLP project in the State of Georgia and the first TLP project constructed by USACE South Atlantic Division (Figure 57). TLP in combination with open water

dispersal is promising beneficial-use placement strategies for mud, muck, and silty material for coastal Georgia and beyond.

Figure 57. Construction of TLP site for AIWW project at Jekyll Creek, GA illustrating placement with an open 18" pipe (left) and distribution of sediment across the five acre site contained with coconut coir logs (right).

Opportunities for Action

The Savannah District could place beach- and nearshore-quality material from Savannah Harbor at the Tybee Island SPP, which could provide significant value to the FRM program. The Savannah District could also use dredged material to enhance their bird island/environmental habitat program. Island creation at Tompkins Island, north of the Savannah River, provides bird habitat and additional capacity at DMMAs as the bird island serves as an offloading option. In addition, the Savannah District placed approximately 530,000 CY at Brunswick Bird Island in 2008. Placement at the island provided direct value to the NAV program based on pumping distance to the placement site and capacity saved at established DMMAs. Other opportunities for development of bird habitat or other beneficial use projects with environmental and economic benefits should be explored as they are supported by stakeholders and resource management agencies.

4.3.2 Savannah Harbor Navigation Project and Tybee Island Shore Protection Project

Summary

SAS manages approximately 7.1 million CY of dredged material from the Savannah Harbor NAV project per dredge cycle (every one to two years) (Figure 58). Opportunities for beneficial use of dredge material include placement at Fort Pulaski National Monument, Tomkins Bird Island, and the Tybee Island Shore Protection Project (SPP).

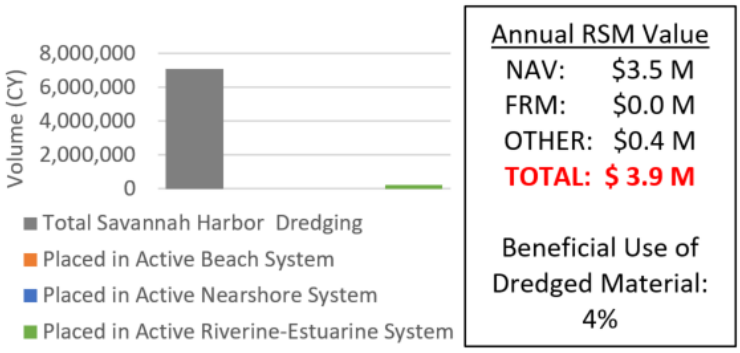


Figure 58. Average volume of sediment dredged from Savannah Harbor per dredge cycle (standard dredge cycle: 1–2 years). Total annual RSM value of $3.9 million achieved by efficiencies identified at Kings Island Turning Basin and $0.4 million from beneficial use placement at Fort Pulaski National Monument.

Concerns about material quality have limited placement at the Tybee Island SPP. Enough beach and nearshore-quality sediment is routinely dredged from Savannah Harbor to provide all sand needed to maintain adequate shore protection at the Tybee Island SPP. Additional quality control measures or nearshore berm placement could alleviate the local sponsor's material quality concerns. Implementation of this RSM strategy could provide $1.1 million in annual value to the FRM program if the NAV and FRM projects are combined, and likely eliminate or drastically reduce the need for a traditional beach nourishment project. Approximately 270,000 CY of beach-quality material was placed at Fort Pulaski beach in 2015 at an estimated value of $1.9 million to the National Park Service. Fort Pulaski is a Civil-War-era fort and historic cultural resource between Savannah and Tybee Island.

In 2018–2019, SAS and the RSM RCX analyzed and executed dredging strategies near Kings Island Turning Basin (KITB) and determined dredging upstream of KITB would increase operational efficiency in the upper harbor and save approximately $3.5 annually (Condon et al., 2019).

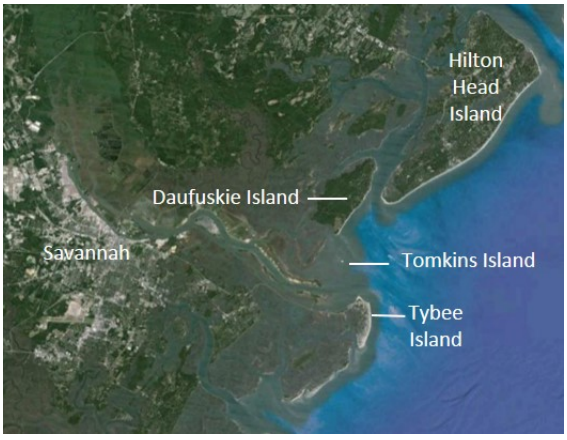


Figure 59. Map illustrating the federal projects at Savannah Harbor and Tybee Island and areas adjacent to the projects.

Introduction

The Savannah Harbor NAV project is located along the South Carolina – Georgia border near the Atlantic Ocean (Figure 59). The federal channel connects the Port of Savannah with the Atlantic Ocean. The Savannah Harbor Expansion Project will deepen the federal channel from -42 feet to -47 feet.

The Tybee Island SPP is 3.5 miles in length and was initially constructed in 1974 with a 50-year project life and estimated renourishment interval of seven years. The beach was last renourished in 2008 and currently has eight years remaining of the 50-year project life.

Beach-quality and Nearshore-quality Material Placement Strategies

A summary of beach and nearshore-quality dredged material placement strategies and total project costs is provided in Figure 60 and Table 25. Approximately 300,000 CY of beach-quality sand is dredged every two years for an annual cost of $1.7 million (NAV 1), and 300,000 CY of nearshore-quality material is dredged every year for an annual cost of $1.6 million (NAV 2). Placement of approximately 1.5 million CY every seven years is required to maintain sufficient shoreline protection for the Tybee Island SPP for an annual cost of $2.1 million (SPP 1).

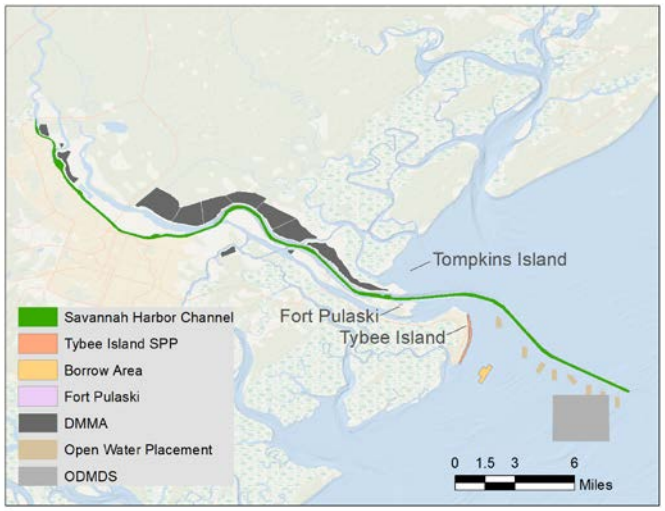


Figure 60. Map of Savannah Harbor material placement strategies. RSM strategies are highlighted in Table 25.

Over seven years, approximately 3.2 million CY of beach- and nearshore-quality material is dredged from the NAV project that could be placed at the SPP. Assuming 25% loss during placement, a total of 2.4 million CY could be beneficially used at the SPP. Implementation of RSM 1 and RSM 2 could minimize or potentially eliminate the need for the traditional FRM project and provide $1.1 million in value to the FRM project if NAV and FRM projects are combined. Local sponsor concerns about quality of material placed on the beach could be alleviated by placing all material in a nearshore feeder berm which could also potentially significantly decrease per CY and mobilization costs as additional equipment for both beach and nearshore placement strategies would not be required.

Approximately 250,000 CY of beach-quality material was placed at Fort Pulaski beach in 2015 at an estimated value of $1.9 million to the National Park Service (RSM 3). Fort Pulaski is a Civil War era fort and historic cultural resource between Savannah and Tybee Island.

Table 25. Summary of Costs and Value of Beach and Nearshore-quality Dredge Material for Project at Savannah Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Savannah Harbor to DMMA	2	$6	300,000	$1.2	$0.3	$3.3	$1.7
NAV 2	Savannah Harbor to ODMDS	1	$3	300,000	$0.2	$0.5	$1.6	$1.6
SPP 1	Offshore Borrow to Tybee Island	7	$7	1,500,000	$1.2	$3.3	$15	$2.1
	Combined Traditional NAV and SPP projects						$20.0	$5.4
RSM 1	Savannah Harbor to Tybee Beach	6	$11	300,000	$1.2	$0.3	$4.8	$0.8
RSM 2	Savannah Harbor to nearshore feeder berm	1	$6	300,000	$1.2	$0.5	$3.5	$3.5
	Combined RSM projects							**$4.3**
					Potential Total Annual Combined RSM 1 and 2 Value:			**$1.1**
RSM 3	Savannah Harbor to Fort Pulaski	**5**	$7	250,000	$1.2	$0.3	$3.3	$0.7
	RSM 3 OTHER Benefit		$10	188,000			$1.8	**$0.4**

NAV 1 and RSM 1 projects are beach-quality material.
NAV 2 and RSM 2 projects are nearshore-quality material.
Total annual combined RSM 1 and 2 value was calculated by subtracting the cost of RSM 1 and 2 from NAV 1 and 2 and SPP. Enough beach- and nearshore-quality material is available from Savannah Harbor to potentially eliminate the traditional SPP project.
RSM 3 was recently executed and provided $1.9 million in one-time shoreline protection benefits to Fort Pulaski National Monument.
RSM 3 OTHER Benefit was estimated based on the volume of sand placed on the beach (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

Silt/Mud Material Placement Strategies

Approximately 6.5 million CY of silt and mud material is dredged from Savannah Harbor annually. Total annual cost for placing 500,000 CY of material in the ODMDS and 6.0 million CY of material in DMMAs is $4.5 and $25.8 million, respectively (Table 26).

The Savannah District and RSM RCX analyzed dredging strategies in the Upper Harbor to optimize operational efficiency and maintenance cost in 2018-2019. Based on analysis of geotechnical data, shoaling rates, hydrodynamic modeling, and recent dredge contract costs, it was determined that additional dredging upstream of KITB in the main channel and Argyle Turning Basin could reduce dredging requirements from biannually to annually, saving a total of $3.5 million in dredging costs annually. Additional benefits include reduced conflicts between dredge plants and container ships that result in a safer and more efficiently operated port.

Table 26. Summary of Costs and Value of Silt/Mud Dredge Material for Project at Savannah Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Savannah Harbor to ODMDS	1	$4	500,000	$1.2	$1.3	$4.5	$4.5
NAV 2	Savannah Harbor to DMMA	1	$4	6,000,000	$1.2	$0.6	$25.8	$25.8

Opportunities for Action

The Savannah District currently beneficially places some material at Fort Pulaski Beach and could place additional beach- and nearshore-quality material at the Tybee Island SPP, which would provide significant value to the FRM program.

4.3.3 Brunswick Harbor Navigation Project

Summary

SAS manages approximately 1.8 million CY of dredged material from the Brunswick Harbor NAV project every year (Figure 61). While most dredge material consists of silt and mud, a significant volume is suitable for nearshore placement. Nearshore placement south of the project channel is a cheap placement option that does not use capacity at upland (DMMAs) or offshore (ODMDSs) placement sites and provides sediment to the downdrift coastal system.

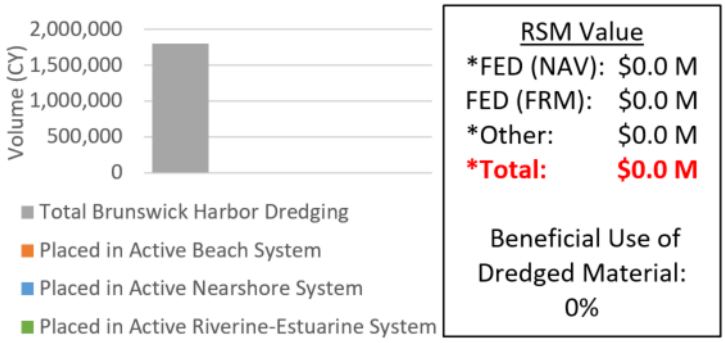


Figure 61. Average volume of sediment dredged from Brunswick Harbor (standard dredge cycle: 1 year).

Placement of nearshore quality material at the nearshore feeder berm could provide $0.9 million in annual value to the NAV program. If placed in the littoral zone, it could provide up to $11.3 million in value to the erosional shoreline along the northern half of Jekyll Island. The open water placement sites adjacent to the channel were most recently used in 2011. All of the open water sites in state waters are currently at capacity and material is placed in the ODMDS. SAS placed 530,000 CY of sand at Brunswick Bird Island in 2008, and nearshore placement as well as placement at Brunswick Bird Island or other environmentally and economically beneficial locations should be explored.

Figure 62. Map illustrating Brunswick Harbor and areas adjacent to the navigation project.

Introduction

The Brunswick Harbor NAV project is located in Glynn County, GA, approximately 30 miles north of the Georgia-Florida border (Figure 62). The federal channel connects the Port of Brunswick with the Atlantic Ocean through St. Simons Sound. St. Simons Island is located north of the Sound and Jekyll Island is located south of the Sound.

Major imports at the Port of Brunswick include wood, paper, grains, and automobiles. Commercial shrimping, recreational fishing, and tourism are economically important to the City of Brunswick and neighboring coastal communities of St. Simons Island and Jekyll Island.

Nearshore-quality Dredged Material Placement Strategies

A summary of nearshore-quality dredged material placement strategies and total project costs is provided in Figure 63 and Table 27. Approximately 1.5 million CY of nearshore-quality material is dredged from the Entrance Channel and placed at the ODMDS annually at a cost of $8.3 million (NAV 1).

The 1.5 million CY of nearshore-quality material could be placed at the open water placement sites south of the project channel at $4/CY for a total project cost of $7.5 million. The value to the NAV program for this placement strategy would be approximately $0.9 million annually.

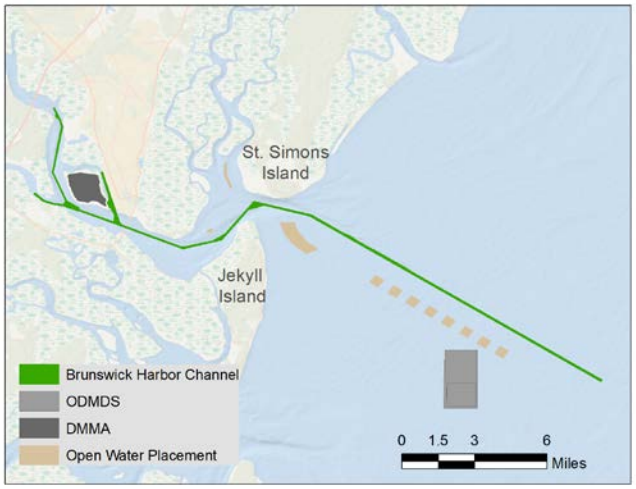


Figure 63. Map of Brunswick Harbor material placement strategies. RSM strategies are highlighted in Table 27.

Table 27. Summary of Costs and Value of Nearshore-quality Dredge Material for Project at Brunswick Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Brunswick Harbor to ODMDS	1	$4	1,500,000	$1.0	$1.3	$8.3	$8.3
RSM 1	Brunswick Harbor to nearshore feeder berm	1	$4	1,500,000	$1.0	$0.5	$7.5	$7.5
	OTHER Benefit A	1	$10	1,125,000			$11.3	$11.3
						Potential RSM 1 NAV Value:		0.9
						Potential Total RSM 1 Value:		**$12.2**

Silt/Mud Material Placement Strategies

Approximately 300,000 CY of silt and mud material is dredged from Brunswick Harbor annually. Total annual cost for placing the material in DMMAs is $5.3 million (Table 28).

Opportunities for Action

In addition to placement of nearshore-quality material in a nearshore feeder berm at Jekyll Island, other beneficial opportunities exist at Brunswick Harbor. SAS placed approximately 530,000 CY at Brunswick Bird Island in 2008. Placement at the island provided direct value to the NAV program based on pumping distance to the placement site and capacity saved at established DMMAs. Other opportunities for

development of bird habitat or other beneficial use projects with environmental and economic benefits should be explored.

Table 28. Summary of Costs and Value of Silt/Mud Dredge Material for Project at Brunswick Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 2	Brunswick Harbor to DMMA	1	$10	300,000	$1.0	$1.3	$5.3	$5.3

4.3.4 Atlantic Intracoastal Waterway (AIWW) Project

Summary

SAS manages approximately 900,000 CY of dredged material from the AIWW per dredging event (Figure 64). Dredging of the AIWW was conducted in 2019 for the first time in over a decade. The 2019 dredging event included two beneficial-use pilot projects through a collaboration with Georgia Department of Natural Resources, Jekyll Island Authority, The Atlantic Intracoastal Waterway Association, and The Nature Conservancy.

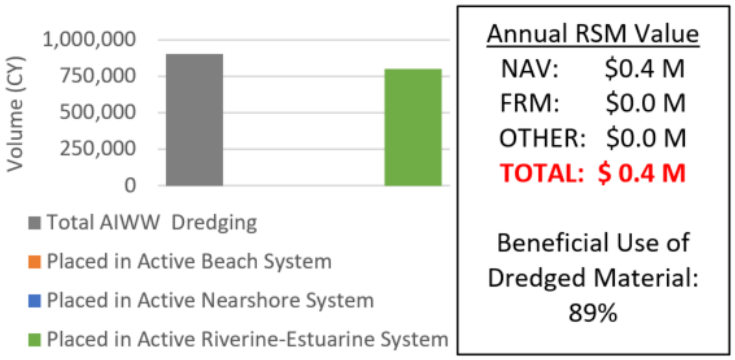


Figure 64. Average volume of sediment dredged from the Georgia AIWW per dredging event. Total annual RSM value is $0.4 million.

The beneficial use pilots included two placement strategies for mud and silty material: TLP and open water dispersal. TLP is an emerging technique to support coastal marshes and enhance coastal resilience as a result of sea level rise. The TLP project was the first of its kind in the State of Georgia and the first TLP project for the South Atlantic Division of USACE. The two pilot projects demonstrated the beneficial use strategies are environmentally acceptable in Georgia and provide an economically viable dredging strategy to support the Georgia AIWW into the future.

Introduction

The AIWW within the Savannah District is 161 miles in length and spans from Port Royal Sound, SC to Cumberland Sound, GA. Project depth is 12 feet MLLW (Figure 65). The Georgia AIWW has not been dredged in over a decade prior to 2019 and contained numerous shoals and areas not safe for navigation. To support safe navigation in Georgia and connectivity and functionality of the AIWW as an overall interstate commerce system, the South Atlantic Division initiated the Jekyll Creek Beneficial Use pilot projects. The pilot projects were designed to develop long-term environmentally acceptable and economically viable dredging solutions for the Georgia AIWW and beyond.

The pilot projects were a collaborative effort between the U.S. Corps of Engineers (SAS, SAJ, RSM RCX), Georgia Department of Natural Resources Coastal Resources Division, Jekyll Island Authority, Atlantic Intracoastal Waterway Association, and The Nature Conservancy. The collaborative team implemented two beneficial use strategies: TLP on the marsh adjacent to Jekyll Creek and open water dispersal at the mouth of St. Simons Sound. TLP is an emerging placement strategy designed to raise marsh surfaces in small incremental lifts to combat the impacts of sea level rise and support coastal resilience. Open water dispersal is a technique designed to keep dredged sediment in the active sediment system by releasing it in a high-energy environment that will support broad dispersal of sediment into the coastal system.

Initial results suggest the two placement strategies were successful and could be implemented in other locations in the South Atlantic Division.

In addition to the pilot projects at Jekyll Creek, additional reaches dredged within the Georgia AIWW in 2019 included creation of bird habitat at Buttermilk Sound and Hells Gate, and confined upland placement at Fields Cut.

All Dredged Material Placement Strategies

A summary of dredged material placement strategies and total project costs is provided in Table 29. Approximately 900,000 CY of sand, silt, and mud/muck is irregularly dredged from the Georgia AIWW. The beneficial use strategies of open water dispersal (RSM 1) and placement on the marsh (RSM 2) are estimated at $10 and $15 per CY with an estimated mobilization cost of $2 million per placement strategy. Placement of dredged material in a confined upland facility is estimated at $21 per CY.

The RSM 2 strategy of marsh placement is based on the Buttermilk Sound and Hells Gate placement to develop bird habitat. The TLP pilot was a small-scale demonstration that placed 5,000 CY over 5 acres of marsh. The scale of the TLP pilot was not large enough to develop cost estimates for larger placement efforts but successfully demonstrated construct-ability of the placement strategy and environmental considerations for future TLP projects.

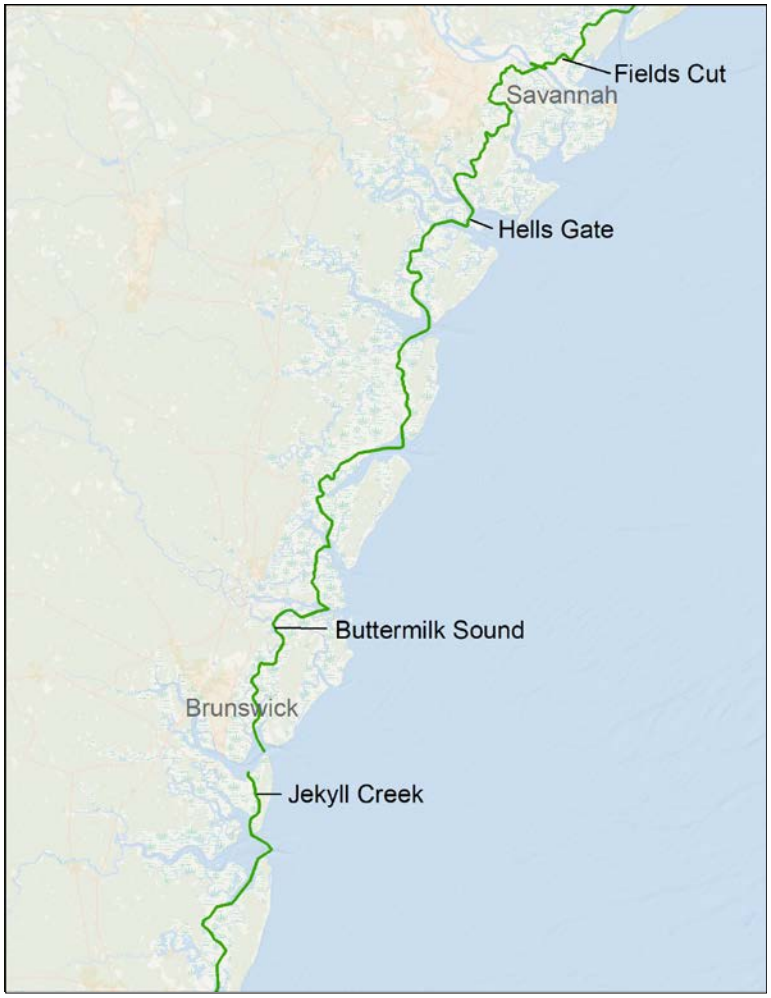


Figure 65. Map of common AIWW dredging locations for SAS. Dredged material placement strategies are highlighted in Table 29.

Table 29. Summary of Costs for Dredge Material Placement Strategies for the Georgia AIWW.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	AIWW to ODMDS	varies	$17	200,000	$0.5	$2.0	$5.9	
RSM 1	AIWW to Open Water	varies	$15	200,000	$0.5	$2.0	$5.5	
						RSM 1 NAV Value:	**$0.4**	
RSM 2	AIWW to Marsh	varies	$10	600,000	$0.5	$2.0	$8.5	
NAV 2	AIWW to Confined Upland	varies	$21	100,000	$0.5	$2.0	$4.6	

*Costs for RSM 2 based on Buttermilk Sound and Hells Gate marsh placement. TLP conducted at Jekyll Creek placed approximately 5,000 CY on the marsh.

Opportunities for Action

The recent execution of the beneficial use pilots resulted in development of placement strategies that can be used in coastal Georgia and beyond. In addition to TLP and open water dispersal, stakeholders and resource agencies are interested in using dredged material to develop bird habitat lost as a result of hurricanes over the past several years. Bird habitat could include longshore bars or development of additional intertidal or sub-aerial features.

4.4 Jacksonville District (SAJ)

The RSM Optimization Update analyzed 40 projects in the Jacksonville District including 19 NAV projects and 21 FRM projects (Figure 66).

4.4.1 Summary of Navigation and Flood Risk Management Projects

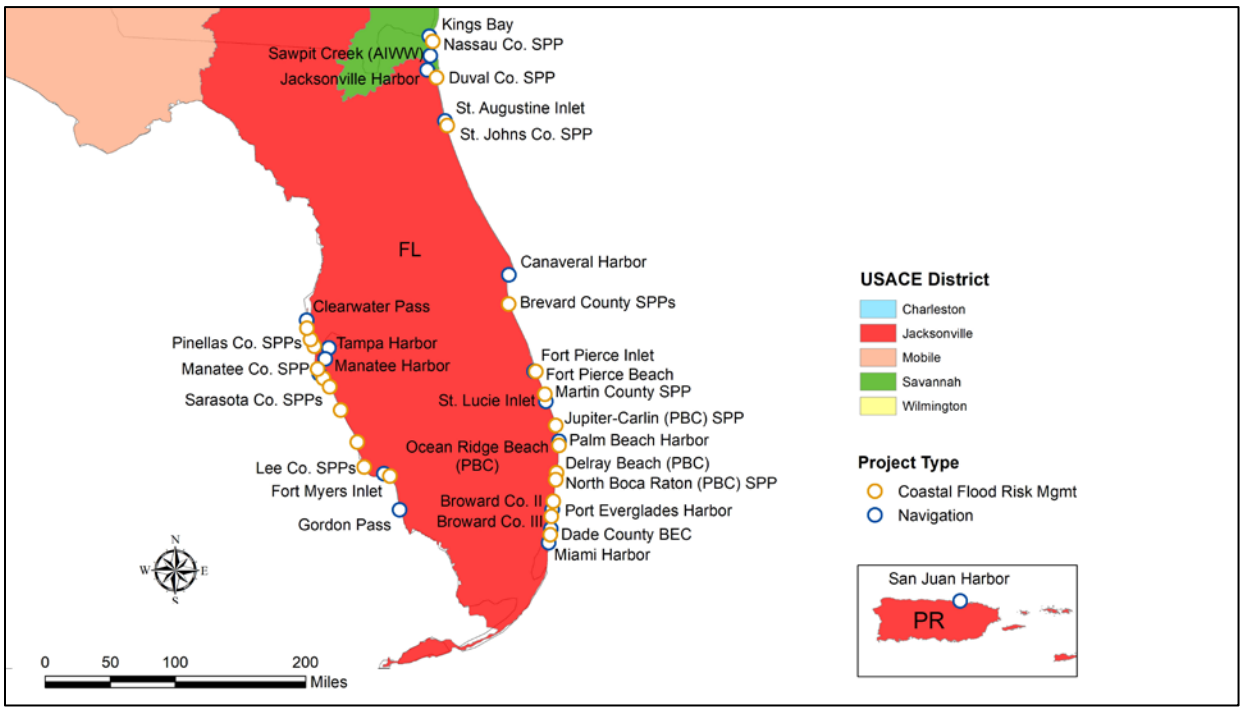


Figure 66. Map of Jacksonville District projects reviewed under the 2020 SAD RSM Optimization Update. Note: the AIWW and Gulf Intracoastal Waterway is not included in the map.

Overview

NAV and FRM projects managed by the Jacksonville District were analyzed for economic and environmental efficiencies related to dredged material placement and beneficial use of dredged material. Implementation of RSM principles provides an estimated $30.6 million in annual value to the Jacksonville District (Figure 67). Based on data from NAV projects in the Jacksonville District, an estimated 10 million CY is dredged per dredge cycle and 59% of the material is managed by RSM principles. An additional $8 million in RSM opportunities was identified during the 2019 Optimization Update.

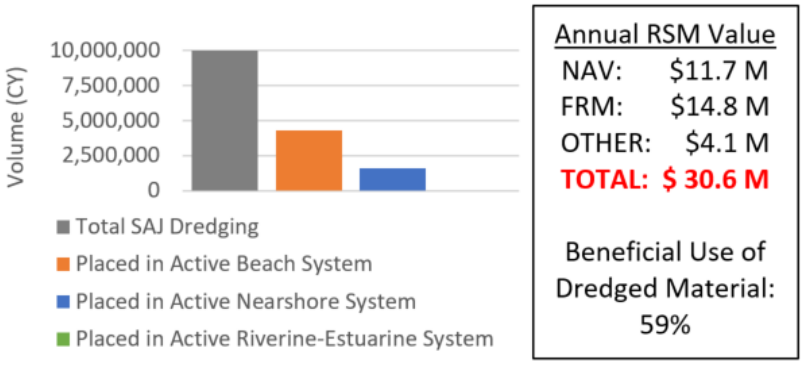


Figure 67. Average volume of sediment dredged from SAJ NAV projects per standard project dredge cycles. Total annual RSM value is $30.6 million.

RSM Value and Sediment Placement

Of the Jacksonville District NAV projects, St. Augustine Inlet, St. Lucie Inlet, Jupiter Intracoastal Waterway (IWW), Broward IWW, Bakers Haulover, Pinellas County Shallow Draft, Manatee County, Fort Myers, and Gordon Pass beneficially place all of the projects' dredged material (Table 30). Kings Bay is the highest dredge volume project in the district (19% of all SAJ dredged material) and provides $4.5 million of annual RSM value. The two next highest volume NAV projects are Tampa Harbor and Canaveral Harbor, which remove 2.3 million CY each per dredge cycle from project channels for a total combined annual RSM value of $5.3 million. Dredging of St. Augustine Inlet to support the St. Johns FRM project provides $4.1 million in annual value.

Of the 59% of material that is managed using RSM principles in SAJ, 42% (4.1 million CY) is placed on beaches and 17% (1.6 million CY) is placed in the nearshore (Figure 68). The majority of NAV projects in the Jacksonville District consist of beach-quality sand that is beneficially placed on adjacent beaches. The total value of beach placement in the Jacksonville District is $18.9 million annually with benefits to FRM projects, other federal agencies (National Park Service, Fish and Wildlife Service), state and county parks, and non-federal beaches at no additional expense to the NAV program. Considering the limited availability and high cost of sand in south Florida (> $30/CY), it is critical that all beach-quality material from navigation channels is beneficially placed.

Table 30: Total Dredge Volume and Value of RSM Implemented Jacksonville District NAV-FRM Projects.

Project	*Total Dredge Volume (CY)	% Managed by RSM Strategies	Annual RSM Value ($ M)
SAJ Total	**9,965,000**	**59%**	**$30.6**
Kings Bay - Nassau Co	1,950,000	36%	$4.5
Sawpit Creek AIWW	250,000	80%	$0.4
Jax Harbor - Duval Co	700,000	43%	$0.6
St. Aug - St. Johns	1,800,000	100%	$4.1
Canaveral - Brevard	1,000,000	0%	$0
Fort Pierce	350,000	57%	$0.5
St. Lucie Inlet-IWW-OWW	200,000	100%	$0.3
Jupiter IWW-Jupiter/Carlin SPP (PBC)	65,000	100%	$0.9
Palm Beach Harbor PBC SPPs	200,000	50%	$0
Broward IWW-Broward II SPP	50,000	100%	$0.9
Port Everglades - Broward III	400,000	25%	$0
Bakers Haulover-Miami Harbor	50,000	100%	$3.9
Pinellas Shallow Draft and SPPs	725,000	100%	$5.3

Project	*Total Dredge Volume (CY)	% Managed by RSM Strategies	Annual RSM Value ($ M)
Tampa Harbor	1,300,000	77%	$5.3
Manatee Harbor	300,000	0%	$0
Manatee County	100,000	100%	$0.3
Sarasota County	0	0%	$0
Lee County - Gasparilla, Captiva	0	0%	$0.8
Fort Myers	225,000	100%	$2.3
Gordon Pass - Keewaydin	100,000	100%	$0.5
San Juan Harbor	200,000	0%	$0

*Total dredge volume calculated as the sum of all material dredged from NAV projects per dredge cycle.

Beach- or nearshore-quality material from Kings Bay, Palm Beach Harbor, Tampa Harbor, and Fort Myers is placed in nearshore environments, providing $8.3 million in value to the Jacksonville District. The Jacksonville District recently placed material from St. Augustine Inlet in a nearshore berm on the St. Johns County Shore Protection Project and placed 400,000 in the nearshore in Volusia County (Figure 69). Each project included monitoring to assess the evolution of the nearshore berm and its effectiveness at reducing storm damage.

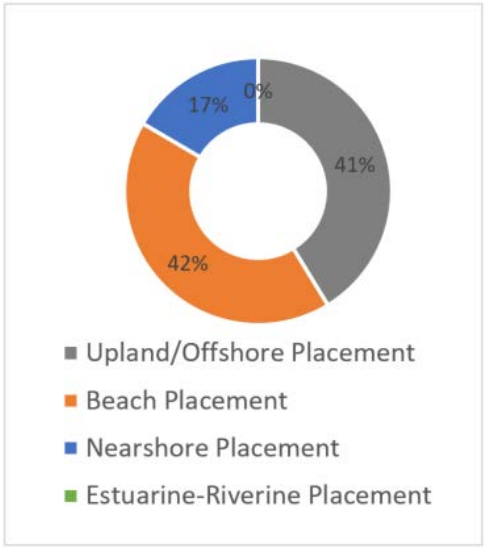


Figure 68. Distribution of placement by category for material dredged from SAJ NAV projects.

A significant volume of dredged material in the district is not suitable for beach or nearshore placement. Currently, beneficial use of this material is limited. One example of beneficial use of this material is the Mile Point Navigation Project, located on the southern side of the intersection of the St. Johns River and Atlantic Intracoastal Waterway in Jacksonville Harbor (Figure 69). The project is associated with the Jacksonville Harbor deepening project and restored 52 acres of salt marsh habitat with 900,000 CY of dredged material from the harbor. The Mile Point Navigation project built additional capacity to support opportunities for additional beneficial use of dredge material in Jacksonville Harbor in the future.

Figure 69. Image of ARGUS camera system monitoring nearshore placement at Volusia County (left) and the Mile Point beneficial use placement and restoration project (right).

Opportunities for Action

The Jacksonville District is efficient at beneficially placing beach-quality sand for most projects, but additional opportunities are available for more efficient use of nearshore material as well as other dredged material (silt, mud, clay, rock). Nearshore placement provides value, but value is primarily to the NAV program as a function of distance to other placement options. FRM benefits are limited because nearshore placement areas often extend beyond the depth of closure and the material is not placed in the littoral zone where it could provide shore protection benefits. The Jacksonville District should consider prioritizing nearshore placement in the littoral zone for established placement areas and development of new placement areas.

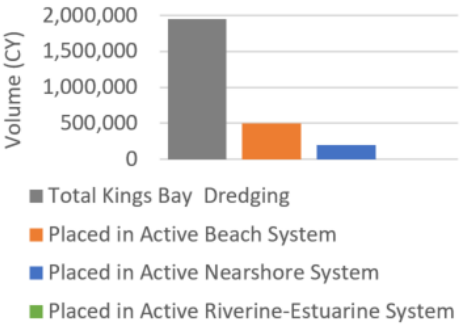
Numerous opportunities for beneficial use of silt, mud, clay, and rock dredged material such as TLP, filling of relict dredge holes, hard bottom habitat creation, and coastal wetland habitat restoration and creation were identified for SAJ District projects during the 2019 RSM Optimization Update. SAJ recently published "A Review of RSM Implementation Strategies and Recommendations for Ecosystem Restoration in Tampa Bay, FL" (Hershorin et al., 2019), which documents opportunities in Tampa Bay and includes estimated costs for each strategy. For most project locations, additional analyses are needed to determine if the opportunities provide added value.

Considering the high cost of upland placement (development, maintenance), it is likely that placement of this dredged material in an environmentally beneficial manner could provide value and be the least-cost option. Jacksonville Harbor beneficially re-uses material from DMMAs for road construction. The Jacksonville District is also working with the Manatee Harbor project sponsor, Manatee County, to offload dredged material to Washington Park, approximately eight miles from the project site. Washington Park contains several pits of low-grade wetlands and the county will use the material to create a public park using approximately 1 million CY of dredged material. The project is a win-win for the Jacksonville District and the project sponsor, Manatee County, as the Jacksonville District reduces dredged material management costs and provides the county with low-cost fill material.

4.4.2 Fernandina Harbor/U.S. Naval Station Kings Bay Maintenance Dredging and Nassau County Shore Protection Project

Summary

SAJ is currently managing dredged material from the 100% Navy funded Kings Bay Maintenance Dredging Project in an environmentally beneficial and economically efficient manner. SAJ beneficially uses beach-quality material on the Nassau County SPP and beach placement areas associated with Fort Clinch and places nearshore-quality material in a nearshore placement area.



Annual RSM Value	
NAV:	$2.8 M
FRM:	$1.7 M
OTHER:	$0.0 M
TOTAL:	**$4.5 M**

Beneficial Use of Dredged Material: 36%

Figure 70. Total volume of sediment dredged from Kings Bay per dredge cycle (standard dredge cycle: 1 year). Total annual RSM value is $4.5 million.

**Implementation of RSM nearshore material placement strategy could provide an additional value of $1.7 million annually to Nassau County (non-federal beach).*

The value of the implemented sediment management strategy is approximately $4.5 million ($3.5 for beach-quality material, $1.0 million for nearshore-quality material) annually with an estimated annual value of $2.8 million and $1.7 million to the NAV and FRM projects, respectively (Figure 70).

Annual value associated with beach-quality material was estimated at $3.5 million because the strategy provides all needed sediment to the Nassau County SPP and provides beach-quality sand to protect Fort Clinch per a legal agreement with the U.S. Navy (Figure 71). As mitigation for downdrift erosion impacts per Section 111, the Kings Bay navigation project is required to pay 50% of the cost for the Nassau County SPP. Therefore, the estimated annual value of $3.5 million to the FRM project is split evenly between the NAV and FRM programs. Beach-quality material is currently placed at the northern reaches of the Nassau County SPP.

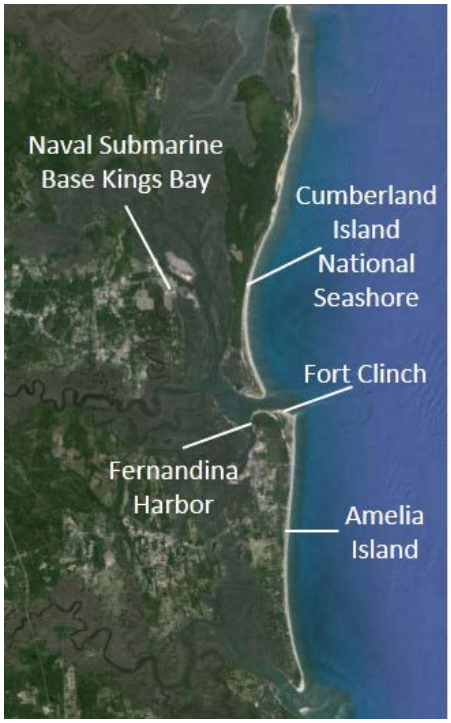


Figure 71. Map of northeast Florida indicating locations of interest associated with the Kings Bay Navigation and Nassau County SPP projects.

Annual value associated with nearshore-quality material was estimated at $1.0 million for the NAV program and is primarily a function of the shorter distance to the nearshore placement area relative to the ODMDS. If the 200,000 CY of nearshore-quality

material was placed within the depth of closure, an additional $1.7 million of value could be attributed to Nassau County in the form of additional storm protection based on the cost of sand from an offshore borrow source.

In February 2019, a version of the Kings Bay Entrance Channel Maintenance Dredging Project was executed in response to Hurricanes Matthew and Irma which included renourishment of the southernmost portion of the Nassau County SPP with sediment dredged from the channel and the North Settling Basin. The final cost of the project was $25.1 M. The standalone cost to dredge the channel based on a northern beach placement was $20 M and a stand-alone contract to renourish the Nassau County SPP using an offshore borrow source was estimated at $26 M. Using the Kings Bay Entrance Channel and North Settling Basin as borrow sources for the Nassau County SPP resulted in significant savings to both projects. The navigation project cost $10.8 M saving $9.2 M and the Nassau County SPP cost $14.3 M saving $11.7M for an overall savings of $20.9 M.

Approximately 1.3 million CY of material is dredged from the project that is not suitable for beach or nearshore placement. Beneficial uses of this material for environmental restoration or other uses should be explored.

Introduction

Fernandina Harbor is collocated with the Kings Bay Naval Station in northeast Florida along the Florida-Georgia border (Figure 72). Due to the depths and maintenance intervals required for Navy operations, the Navy fully funds SAJ for all dredging related to Fernandina Harbor/Kings Bay. For the purposes of this report, the project will be referred to as Kings Bay. Cumberland Island National Seashore (U.S. National Parks Service) is north of Kings Bay and Amelia Island, Nassau County (FL) is directly to the south.

Approximately 350,000 cubic yards (CY) of beach-quality material, 200,000 CY of nearshore-quality material, and 1.3 million CY of additional material is dredged annually from the Kings Bay Maintenance Project. All beach-quality and nearshore-quality material is located in the Entrance Channel. Placement options for dredge material include standard DMMA and ODMDS options as well as authorized beach and nearshore placement areas associated with the Nassau County SPP and Fort Clinch, a Civil War era fort and state park. An estimated 1 million CY is required every eight years to maintain sufficient storm risk reduction for the project's 50-year period of federal participation.

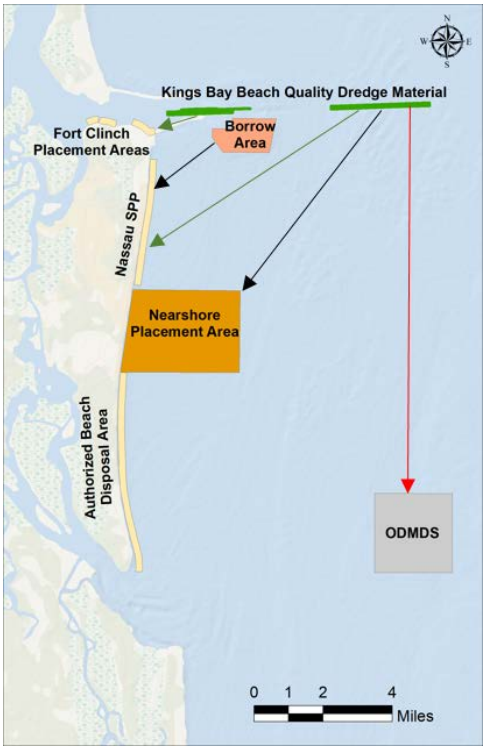


Figure 72. Map of Kings Bay Entrance Channel and beach quality material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 31.

A Section 111 determination for Nassau County impacts from the Navigation project requires that the NAV program cost share 50% of beach placement costs. The remaining cost for Nassau County is shared with the non-federal sponsor at approximately 65%/35%, which is based on shoreline ownership and land use at the time of construction.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 72 and Table 31. The relative cost per CY is primarily a function of distance to the placement sites and equipment and effort required for placement at the individual sites. The project cost for placement of beach-quality material at the ODMDS is approximately $10/CY for a total project cost of $6.7 million annually. The cost of placing sand at the Nassau County SPP from the borrow area is $11/CY for a total average annual project cost of $4.3 million annually. SAJ has executed RSM strategies 1 and 1a which place beach-quality material at the Nassau SPP and Fort Clinch at a cost of $25/CY and $13/CY, respectively, for a total project cost of $16.1 million. Placement at Fort Clinch, a state park, is based on a legal agreement with the U.S. Navy. Execution of the RSM strategies provides value of $3.5 million annually and eliminates the need for the Nassau County SPP to use an authorized offshore sand source, located approximately 4 miles from the project.

Table 31. Summary of Costs and Value of Beach-quality Material for Projects at Kings Bay and Nassau County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Kings Bay to ODMDS	1	$10	350,000	$0.5	$2.7	$6.7	$6.7
SPP 1	Borrow Area to Nassau SPP	5	$11	1,500,000	$1.5	$3.3	$21.3	$4.3
NON-RSM 1	Combined Traditional NAV and SPP Projects						$28.0	$11.0
RSM 1	Kings Bay to Nassau SPP North	2	$25	350,000	$0.5	$4.9	$14.2	$7.1
							RSM Value Strategy 1:	$3.9
*RSM 1a	Kings Bay to Ft. Clinch	2	$13	150,000			$2.0	$1.0
	OTHER Benefit A	2	$11	112,500			$1.2	0.6
							TOTAL Combined RSM Value Strategies 1-1a:	**$3.5**

RSM value is based on the removal of the traditional SPP as sufficient beach-quality material is placed on the beach from the NAV project ($11.0M – 7.1 M = $1.5 M) plus the value of placement on the non-federal beach at Fort Clinch (0.6 M minus the additional cost of placement at Fort Clinch of $1.0 M)

Value for RSM 1 is split equally between NAV and FRM programs as NAV is required to mitigate the FRM project at 50%.

OTHER Benefit A was estimated based on the volume of sand placed on the beach from RSM 1a (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

*The overall RSM strategy is a combination of Fed-Fed and Fed-State projects as Ft. Clinch is a state park and placement is required at Ft Clinch per legal agreement with U.S. Navy.

Nearshore-quality Material Placement Strategies

A summary of nearshore-quality material placement strategies, total project costs, and value is provided in Table 32. Strategies for placement of nearshore-quality material from Kings Bay include placement in the ODMDS at an estimated cost of $15/CY and in the nearshore placement area at a cost of $11/CY. SAJ has executed the RSM strategy for nearshore-quality material for the past several years at a savings of $1.0 million annually relative to the ODMDS option. All quantified value is derived from savings associated with the cost of placement which is primarily a function of the shorter distance to the placement site. There are additional shoreline benefits associated with keeping material in the littoral system: increased shore protection, environmental, etc. The designated nearshore placement area encompasses areas within and beyond the active littoral system. Since data was not available to determine if material has been placed in the active littoral system to-date, additional shore protection benefits were not quantified for this project. Additional shoreline benefits were estimated at $0.8 million annually if the material was placed within the depth of closure. Future placement of nearshore-quality material in the nearshore placement area should consider placement of material in the littoral system.

Table 32. Summary of Costs and Value of Nearshore-quality Material for Projects at Kings Bay and Nassau County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Kings Bay to ODMDS	1	$15	200,000	$0.5	$1.2	$4.7	$4.7
RSM 1	Kings Bay to Nassau Nearshore Placement Area	1	$11	200,000	$0.5	$1.1	$3.7	$3.7
							RSM Value Strategy 1:	**$1.0**
	Potential OTHER Benefit A	1	$11	150,000			$1.7	$1.7

RSM value for strategy 1 was calculated by subtracting the cost of the RSM 1 strategy from the NAV - non-RSM project total.
Potential OTHER Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 times the cost per CY from an offshore borrow source.

Opportunities for Action

A significant amount of material is dredged from the Kings Bay Maintenance Dredging project that is not suitable for beach or nearshore placement. This material, predominantly located in the Inner Channel, is currently placed in a DMMA at a cost of $6/CY and may be utilized for environmental benefits. Alternative placement of dredge material in shallow, lower energy areas of rivers and estuaries as well as on marshes is a beneficial use gaining interest within the coastal management community. Environmental benefits include restoring intertidal areas, reducing wave energy, and restoring marsh elevations. Other potential beneficial uses of dredge material in the project area include filling of relict dredge holes and island habitat creation.

4.4.3 Sawpit Atlantic Intracoastal Waterway Maintenance Dredging – Nassau Sound

Summary

SAJ manages the Sawpit Creek (Nassau County, FL) portion of the AIWW Channel as part of the larger AIWW Norfolk to St. Johns project. Approximately 200,000 CY of beach-quality material and 50,000 CY of finer-grained material is dredged from Sawpit AIWW every five years. SAJ places beach-quality material on the beach at Amelia Island State Park and places other dredged material at an adjacent DMMA.

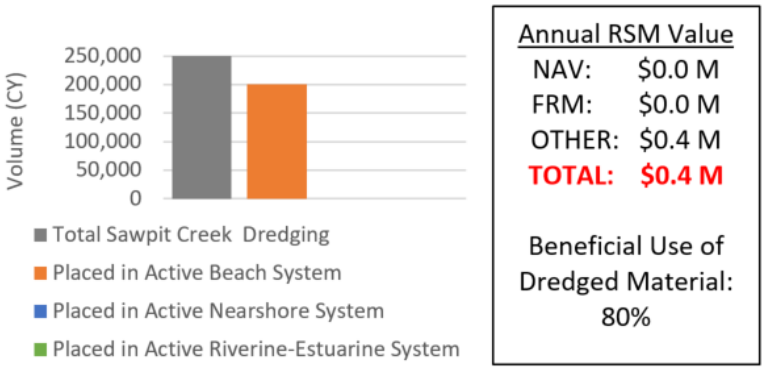


Figure 73. Total volume of sediment dredged from AIWW Sawpit per dredge cycle (standard dredge cycle: 5 years). Total annual RSM value is $0.4 million.

The value associated with this sediment management strategy is approximately $0.4 million annually as a result of beach-quality sand being placed at Amelia Island State Park at no expense to the state park (Figure 73). Capacity at the designated DMMA is a limiting factor and the project would likely not be possible to maintain without executing the RSM strategy. In addition, the sand placed at Amelia Island State Park supports recreation and environmental habitat for nesting birds and sea turtles. A significant amount of material is available to be dredged from the project that is not suitable for beach placement. Beneficial uses of this material for environmental restoration such as development of islands for bird habitat in Nassau Sound have drawn interest from the Audubon Society and should be explored.

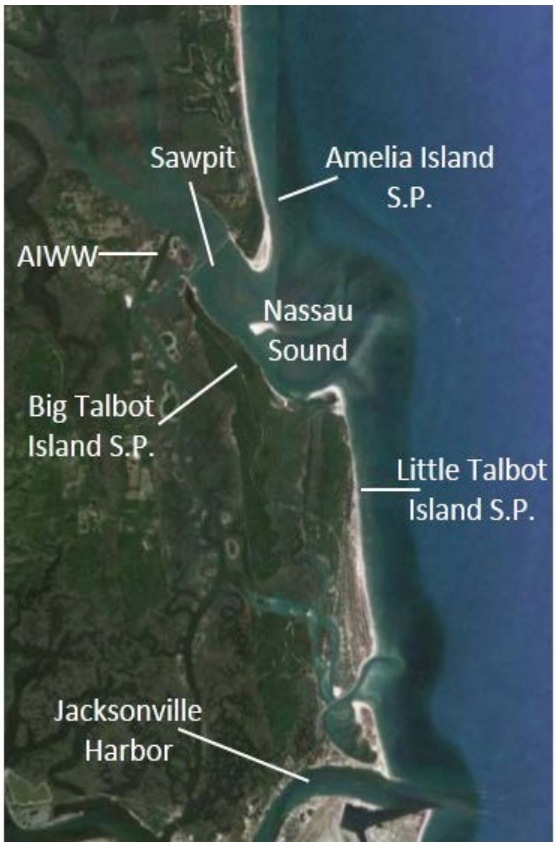


Figure 74. Map of Sawpit AIWW area indicating locations of interest near the Navigation project.

Introduction

The Sawpit AIWW Navigation project is located at the junction of the AIWW and Nassau Sound near the Nassau and Duval County line (Figure 74). Amelia Island State Park and Big Talbot Island State Park are located adjacent to the project site and Little Talbot Island State Park is located to the southeast of the project site.

Placement options for dredge material include placement at a DMMA (DU2) and on the beach at Amelia Island State Park.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project cost, and RSM value is provided in Figure 75 and Table 33. The cost for placement of material at the DMMA and on the beach at Amelia Island State Park is approximately $9/CY. Capacity at the DMMA is limited and would require offloading of material to accommodate the total volume of dredged material from the navigation project in the future.

The Jacksonville District currently places all beach-quality material on the beach at Amelia Island State Park for an annual value of $0.4 million to the state park. Placement on the beach provides recreational opportunities and valuable environmental habitat for nesting birds and sea turtles at the state park. While the environmental and recreational benefits to the state park have not been quantified, SAJ estimates the shore protection value to the state park beach to be $0.4 million annually (assuming $11/CY for placement if state park conducted project independently). The implemented RSM strategy is a win-win for USACE and Amelia Island State Park as USACE saves money for the NAV project and minimizes DMMA management costs and Amelia Island State Park receives recreational and environmental benefits at no cost to the park.

Figure 75. Map of AIWW at Nassau Sound and beach quality material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 33.

Opportunities for Action

A significant amount of material is dredged from the Sawpit AIWW project that is not suitable for beach placement is placed in a DMMA at a cost of $11/CY. The material that is traditionally placed in the DMMA may be utilized for environmental benefits. Three state parks are located within the vicinity of the Sawpit AIWW project and provide opportunities to explore promotion of SAV growth and restoring marsh elevations. Intertidal shoals and islands in Nassau Sound provide habitat for migratory birds and the Audubon Society has shown interest in opportunities to enhance migratory bird habitat which could potentially utilize dredged material from the Sawpit AIWW project.

Table 33. Summary of Costs and Value of Beach-quality Material for Project at Sawpit AIWW.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Sawpit AIWW to DMMA	5	$11	200,000	$0.2	$0.8	$3.2	$0.6
*RSM 1	Sawpit AIWW to Amelia Island State Park	5	$9	200,000	$0.2	$0.8	$2.8	$0.6
							RSM Value Strategy 1:	$0.08
	OTHER Benefit A	5	$11	150,000			$1.7	$0.3
							TOTAL Combined RSM Value Strategy 1:	**$0.4**

RSM value was calculated by subtracting the cost of the RSM strategy from the NAV upland placement option.
OTHER Benefit A was calculated by assuming a cost of $10/CY for placement on Amelia Island State Park from an offshore borrow source.
*RSM 1 option is a combination of Fed-State projects as Amelia Island State Park is managed by the State of Florida.

4.4.4 Jacksonville Harbor Maintenance Dredging and Duval County Shore Protection Projects

Summary

SAJ manages the Jacksonville Harbor federal NAV and the 100% Navy funded U.S. Naval Station Mayport Maintenance Dredging Projects. SAJ places beach-quality dredged material from Jacksonville Harbor on the Duval County SPP. As a result, a value of approximately $0.6 million annually is realized by the FRM project (Figure 76).

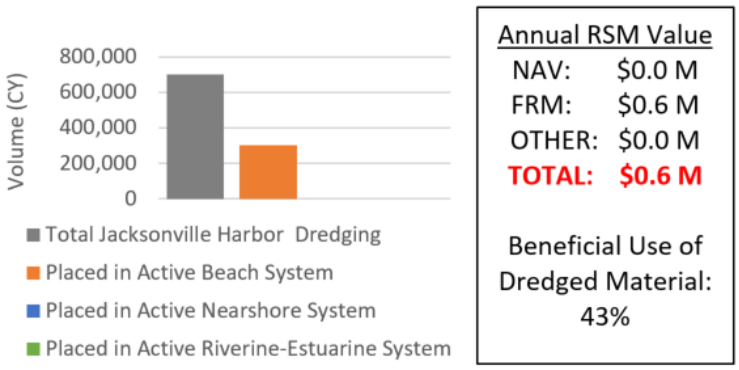


Figure 76. Total volume of sediment dredged from Jacksonville Harbor per dredge cycle (standard dredge cycle: 2 years). Total annual RSM value is $0.6 million.

RSM strategies have been implemented for beach-quality material but additional planning and coordination is required to implement strategies for nearshore-quality material. Value of approximately $0.1 million annually to the FRM program could be realized if the material is placed in the nearshore placement areas within the depth of closure. Historic implementation of RSM principles for beach-quality material at Jacksonville Harbor has prevented the need for mitigation of Duval County beaches downdrift of the harbor. RSM value is realized by combining business lines (NAV and FRM) to calculate a net positive value for beach-quality material, and beach-quality material from Jacksonville Harbor is the cheapest source of beach-quality sand.

Beneficial uses of other dredged material for environmental restoration and other uses should be explored. The Jacksonville Harbor Mile Point Project, located on the southern side of the intersection of the St. Johns River and Atlantic Intracoastal Waterway, created 52 acres of wetland habitat by beneficially using dredged material associated with the Jacksonville Harbor deepening project.

Figure 77. Map of Jacksonville Harbor area.

Introduction

The Jacksonville Harbor Navigation project is located on the St. Johns River and consists of 20 river miles starting at the mouth of the river that empties into the Atlantic Ocean (Figure 77). Projects in Jacksonville Harbor include deepening to 47 feet and the recently completed Mile Point Navigation Project. The projects

have facilitated National Economic Development (NED) by allowing for more efficient use of the harbor by larger vessels as well as improving vessel safety. The Jacksonville District also manages Maintenance Dredging for Naval Station Mayport as part of an agreement with the U.S. Navy and Marine Corps Support Facility Blount Island for the United States Marine Corps.

North of Jacksonville Harbor are several parks including Big Talbot Island State Park, Little Talbot Island State Park, and Huguenot Memorial Park. Naval Station Mayport and the Duval County SPP are located south of Jacksonville Harbor. Approximately 700,000 CY of material is dredged from Jacksonville Harbor per dredge cycle. Placement options for dredge material include multiple DMMAs and an ODMDS as well as authorized beach and nearshore placement areas associated with the Duval County SPP. An estimated one million CY is required every four years to maintain sufficient storm risk reduction for the project.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 78 and Table 34. The project cost for placement of beach-quality material at the ODMDS is approximately $8/CY for a total average project cost of $1.3 million annually. The cost of placing sand at the Duval County SPP from the offshore borrow area is $15/CY for a total project cost of $4.8 million annually. SAJ executes RSM Strategy 1, which places beach-quality material at the Duval County SPP (Mayport Beach in Figure 78) at a cost of $16/CY for a total project cost of $2.8 million annually. Placement at the southern portion of the Duval County SPP is more expensive than the Mayport Beach option primarily due to the increased distance to the placement site and additional equipment and effort required for placement.

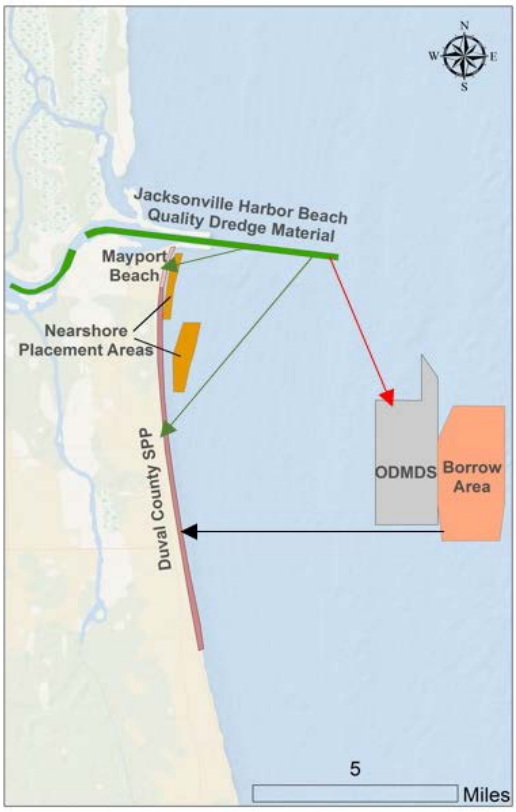


Figure 78. Map of Jacksonville Harbor Entrance Channel and beach quality material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 34.

The RSM strategy can account for approximately 40% of the sand needed to maintain shoreline protection for the Duval County SPP. Placement of beach-quality sand on the beach provides $1.1 million in annual benefits to the FRM program at no cost to the FRM program. By providing 40% of the SPP sand requirements, the nourishment interval is increased from four to five years, conservatively, which reduces the annual cost from $4.8 million to $3.8 million for an additional value of $1.0 million. The total net value of the RSM strategy is $600,000 annually. By placing beach material at Mayport Beach and potentially placing nearshore-quality material at the northern third of the project, additional value could be realized by limiting the focus of the traditional SPP to the southern two-thirds of the project area.

Table 34. Summary of Costs and Value of Beach-quality Material for Projects at Jacksonville Harbor and Duval County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Jax Harbor to ODMDS	3	$8	300,000	$0.5	$1.0	$3.9	$1.3
SPP 1	Borrow Area to Duval SPP	4	$15	1,000,000	$1.0	$3.2	$19.2	$4.8
NON-RSM 1	Combined Traditional NAV and SPP Projects							$6.8
RSM 1	Jax Harbor to Duval SPP North (Mayport)	3	$16	300,000	$1.7	$1.9	$8.4	$2.8
	FRM Benefit A	3	$15	225,000			$3.4	$1.1
	FRM Benefit B							$1.0
							RSM Value Strategy 1:	**$0.6**

RSM value for Strategy 1 was calculated by subtracting the cost of RSM 1 from NAV 1 and adding FRM Benefits A and B.
FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.
FRM Benefit B was estimated assuming the RSM project provides approximately 40% of the needed volume to maintain shoreline protection at the SPP (450,000 CY of 1,000,000 CY every six years). The additional sand would increase the project interval from four to over five years and reduce the annual cost to $3.8 million for a net value of $1.0 million.

Nearshore-quality Material Placement Strategies

A summary of nearshore-quality material placement strategies, total project costs, and value is provided in Figure 78 and Table 35. Strategies for placement of nearshore-quality material from Jacksonville Harbor are placement in the ODMDS at a cost of $9/CY and in the nearshore placement area at a cost of $17/CY. Placement of dredged material from FY15 included placement of beach-quality material on Mayport Beach and placement of all other material in DMMAs. While not the cheapest placement option, when NAV and FRM business lines are combined, placement of approximately 200,000 CY in the nearshore placement areas within the depth of closure could provide a net value of $100,000 annually and support shoreline protection needs throughout the northern third of the Duval SPP.

Opportunities for Action

A significant amount of material is dredged from Jacksonville Harbor that is not suitable for beach or nearshore placement. This material is currently placed in a DMMA or ODMDS at a cost of $7 - $21/CY. Some of this material may be utilized for environmental benefits. Thin-layer placement of dredge material in shallow, lower energy areas of rivers and estuaries as well as on marshes is a beneficial use gaining interest within the coastal management community. Environmental benefits include promotion of SAV growth and restoring bay and marsh elevations. Big Talbot Island State Park, Little Talbot Island State Park, Huguenot Memorial Park, and Mile Point provide areas for environmental enhancement opportunities. Other potential beneficial uses of dredge material in the project area include filling of relict dredge holes and island habitat creation.

Table 35. Summary of Costs and Value of Nearshore-quality Material for Projects at Jacksonville Harbor and Duval County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Jax Harbor to ODMDS	2	$9	200,000	$0.5	$1.0	$3.3	$1.7
RSM 1	Jax Harbor to Duval Nearshore Placement Area	2	$17	200,000	$1.0	$1.0	$5.4	$2.7
	Potential FRM Benefit A	2	$15	150,000			$2.3	$1.1
							Potential RSM Value Strategy 1:	**$0.1**

RSM value for Strategy 1 was calculated by subtracting the cost of the NAV project from the RSM project and adding Potential FRM Benefit A. Potential FRM Benefit A was estimated based on the volume of sand placed in the nearshore from RSM 1 times the cost per CY from an offshore borrow source.

4.4.5 St. Augustine Inlet and Atlantic Intracoastal Waterway (AIWW) St. Augustine Maintenance Dredging and St. Johns County Shore Protection Project

Summary

SAJ uses the St. Augustine NAV project and ebb shoal as the sand source for the St. Johns County SPP. As a result of beneficially using the channel and ebb shoal material for the SPP project, approximately $4.1 million of value is realized annually with an estimated value of $0.6 million to the Flood Risk Management project and $3.5 million to the NAV project (Figure 79).

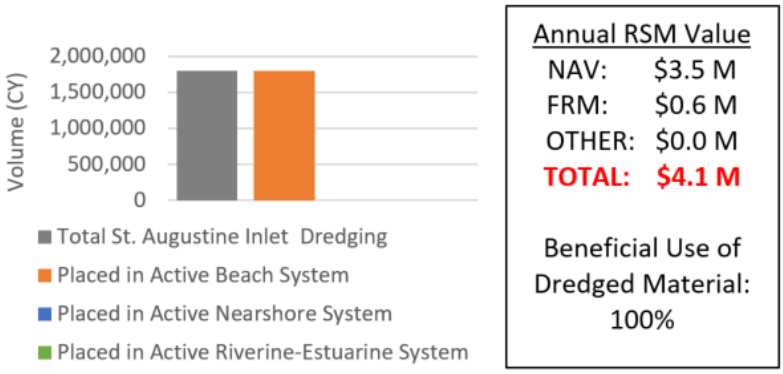


Figure 79. Total volume of sediment dredged from St. Augustine Inlet in 2012 and 2013 (standard dredge cycle: 3 years). Total annual RSM value is $4.1 million.

An annual value of $3.5 million was estimated to the FRM project assuming 75% of the material dredged for the St. Johns SPP was dredged from the NAV channel including overdepth and 25% from advance maintenance areas (e.g., ebb shoal complex). The annual value to the FRM program as a result of RSM strategies was estimated at $1.2 million due to the comparative distance to the inlet borrow area versus a traditional sand source located further offshore. As mitigation for downdrift erosion impacts per Section 111, the NAV project must pay 50% of cost of the SPP project. As a result, $0.6 million of value was attributed to the NAV project and $0.6 million was attributed to the FRM project. Implementation of the RSM strategy to utilize the channel and ebb shoal as a sand source was the only viable option to execute both the NAV and FRM projects as the benefit to cost ratio was not sufficient under traditional sediment management strategies to execute the projects.

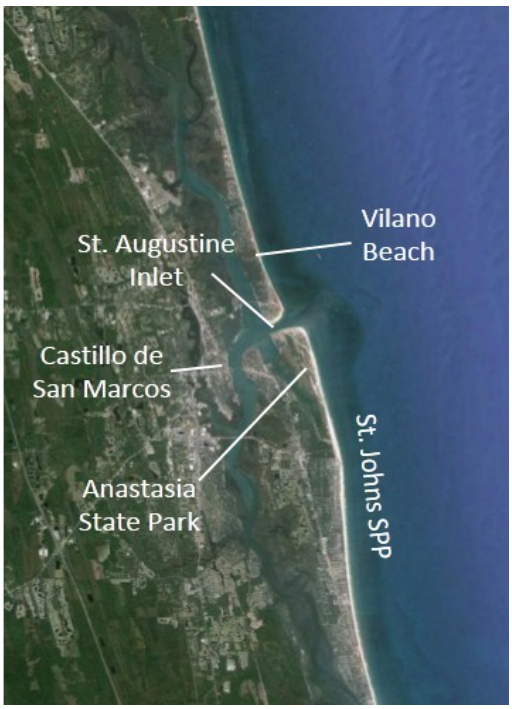


Figure 80. Map of St. Augustine Inlet indicating locations of interest near the NAV and FRM projects.

Introduction

The St. Augustine Inlet NAV Project is located in St. Johns County adjacent to Castillo de San Marcos National Monument and the Historic City of St. Augustine (Figure 80). The St. Johns SPP is located south of Anastasia State Park. Approximately 75,000 – 200,000 CY of beach-quality material is dredged from the St. Augustine Inlet channel and AIWW reaches every three to five years and approximately 1,500,000 – 2,000,000 CY is dredged from the ebb shoal and

channel of St. Augustine Inlet every five years, which serves as the borrow area for the St. Johns SPP. Dredge material is predominantly beach-quality and placement options for the material include placement at a DMMA, on the St. Johns SPP, along a park north of the inlet, and in a nearshore area north of the inlet (Figure 81).

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project cost, and RSM value is provided in Figure 81 and Table 36. The project cost for placement of beach-quality material at an ODMDS from the inner channel of St. Augustine Inlet is approximately $12/CY (no permitted ODMDS, cost estimated based on other projects in the region), and the cost for placement on the beach at the St. Johns SPP is $15/CY. The cost of placing sand at the St. Johns SPP from the inlet borrow area is $9/CY, while placement from a traditional offshore borrow area was estimated (cost based on other projects in region, no traditional offshore borrow are permitted) at $15/CY.

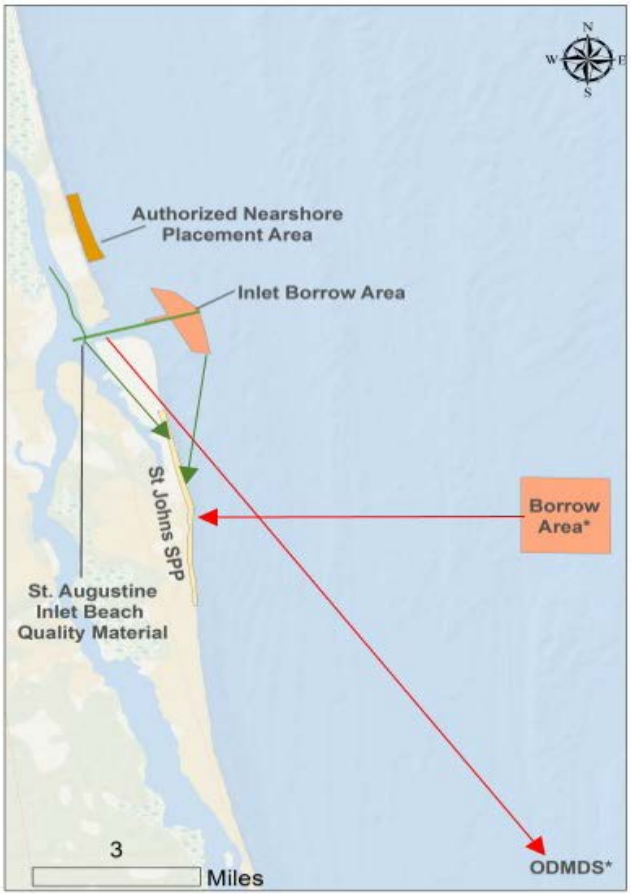


Figure 81. Map of St. Augustine Inlet and St. Johns SPP beach quality material placement strategies. RSM strategies are indicated by green arrows which correspond to highlighted strategies and value identified in Table 36.

**Offshore borrow area and ODMDS are currently not permitted. Cost estimates based on distances and costs of other projects in the region to estimate traditional offshore placement and borrow area costs.*

SAJ executes RSM Strategy 1 which utilizes the ebb shoal and channel of St. Augustine Inlet as a borrow area for the St. Johns SPP. The strategy is a cheaper option for beach-quality sand than an offshore borrow area and provides benefit to the NAV project by maintaining project depth at no expense to the NAV project. Execution of this efficient and cost-effective strategy provides an annual value of $1.2 million to the NAV and FRM project primarily due to the shorter distance between the placement and borrow areas. The $1.2 million in value is split evenly between the NAV and FRM programs as a result of Section 111 mitigation (50%) from the federal navigation project. An additional annual value of $2.9 million is attributed to the NAV project assuming 75% of the material used for the FRM project would need to be dredged from the NAV project to maintain project depth.

Table 36. Summary of Costs and Value of Beach-quality Material for Projects at St. Augustine Inlet and AIWW St. Augustine.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	St. Augustine Inlet to ODMDS	3	$12	200,000	$0.5	$1.0	$3.9	$1.3
SPP 1	Borrow Area to St. Johns SPP	5	$15	1,600,000	$1.1	$3.3	$28.4	$5.7
NON-RSM 1	Combined Traditional NAV and SPP Projects							$7.0
RSM 1	Inlet Borrow Area to FRM	5	$9	1,600,000	$1.0	$2.9	$18.3	$3.7
	St. Augustine Inlet to Beach	3	$13	200,000	$1.0	$2.7	$6.2	$2.1
	Total Combined Projects							$5.7
							RSM Value Strategy 1:	$1.2
	Additional NAV Benefit A	5	$12	1,200,000			$14.4	$2.9
							TOTAL RSM Value Strategy 1:	**$4.1**

RSM value was calculated by subtracting the total combined RSM 1 strategy from the Non-RSM project and adding additional FRM benefit A. Additional NAV benefit A was estimated assuming 75% of material removed from inlet borrow area (from SPP 1,600,000 CY volume) is from the navigation channel or advanced maintenance of channel.

Opportunities for Action

St. Augustine Inlet is predominantly composed of beach-quality sand throughout the project and the current RSM strategy efficiently distributes sediment, where needed, throughout the system providing a remarkable $4.1 million in annual value relative to traditional sediment management strategies. Additional opportunities could focus on longer-term solutions at erosional hotspots on the beach north of the inlet.

4.4.6 Canaveral Harbor and Brevard County Shore Protection Projects

Summary

SAJ manages the Canaveral Harbor NAV Project and the 100% federal Brevard North Reach SPP. SAJ partners with Brevard County to manage the Brevard County Mid Reach and South Reach SPPs. SAJ spends approximately $6 million annually to provide storm damage reduction benefits to Brevard North Reach via sand bypassing and traditional beach nourishment. Identified RSM opportunities, if implemented, could provide up to $2.2 million in annual value for managing 0.5 million CY of beach- and nearshore-quality dredge material .

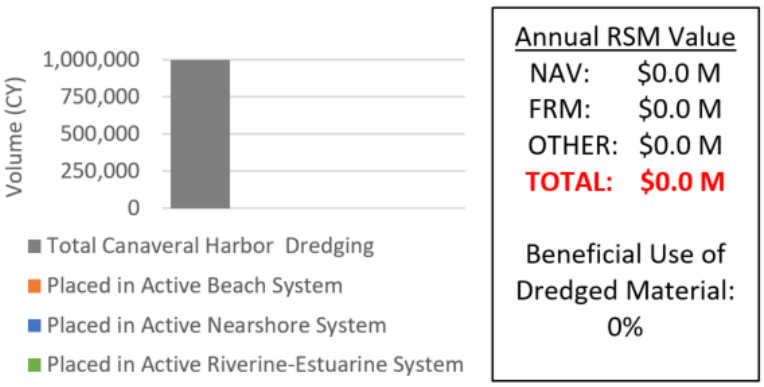


Figure 82. Total volume of sediment dredged from Canaveral Harbor per dredge cycle (standard dredge cycle: 3 years).

Approximately 150,000 CY of beach-quality material is dredged from Canaveral Harbor every three years which could be placed on Brevard North Reach at a value of $1.4 million annually to the NAV program (all value attributed to the FRM program which requires 100% mitigation from NAV) (Figure 82). Placement of the dredge material at Brevard North Reach could account for up to 40% of the sand required to maintain adequate storm protection that is currently provided from a traditional offshore borrow source every six years. An additional 500,000 CY is placed on Brevard North from a sand bypassing project every six years. While there no economic RSM value associated with sand bypassing relative to other sand sources, benefits include keeping sediment in the active littoral system that would naturally feed the North Reach SPP and it eliminates the need to supplement the SPP with additional offshore sediment.

Figure 83. Map of the Canaveral Harbor Navigation and Brevard County SPP projects and areas of interest adjacent to the projects.

Approximately 350,000 CY of nearshore-quality material is dredged from Canaveral Harbor every three years and is placed in the ODMDS. Approximately $0.8 million of value could be realized annually for the NAV project if the material was placed in the littoral zone of the nearshore placement area. FRM benefits of placing the material in the nearshore placement area could include reduced volume requirements from the sand bypassing and offshore dredging projects and increased lifecycle of the authorized offshore borrow

source. Approximately 500,000 CY of material is dredged from the project that is not suitable for beach or nearshore placement. Beneficial uses of this material for environmental restoration or other uses should be explored. RSM value is realized within the NAV Program for both RSM beach-quality and nearshore-quality material placement strategies.

Introduction

The Canaveral Harbor Navigation project is located in central Florida on the Atlantic Ocean south of Cape Canaveral (Figure 83). The Cape Canaveral Air Force Station, Canaveral National Seashore, and Kennedy Space Center are located north of the project and the Brevard County SPPs are located to the south. Brevard County SPPs include beach placement areas at North Reach, Mid Reach, and South Reach. Approximately 150,000 CY of beach-quality material, 350,000 CY of nearshore-quality material and 500,000 CY of additional material is dredged every three years from the Canaveral Harbor project. Placement options for dredge material include standard DMMA and ODMDS options as well as authorized beach and nearshore placement areas associated with the Brevard County SPPs (Figure 84): North Reach, Mid Reach, and South Reach. An estimated 1 million CY is required every 6 years to maintain sufficient storm risk reduction for the North Reach, which is provided by sand bypassing from north of Canaveral Harbor and material from an offshore borrow source. Approximately 600,000 CY, which is currently provided from an offshore borrow source, is required every 6 years to maintain sufficient storm risk reduction for South Reach.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Table 37. The relative cost per CY is primarily a function of distance to the placement sites and equipment and effort required for dredging and placement at the sites (see Figure 84 for project specific locations). The 100% federal Brevard North SPP is currently managed utilizing sand bypassing and an offshore borrow source. While there is no calculated RSM value associated with sand bypassing, it is consistent with RSM principles. Benefits include keeping sediment in the active littoral system that would naturally feed the North Reach SPP, and eliminating the need to supplement the SPP with additional offshore sediment. Placement of approximately 150,000 CY of beach-quality sand onto Brevard North SPP would provide a value of $0.3 million annually to the NAV program due to the value of sand provided to the FRM project at no cost to the FRM project, and extending the nourishment interval. Placement of 220,000 CY of sand on the beach over a six year period (assuming 25% loss during placement) accounts for 40% of the sand provided from a traditional

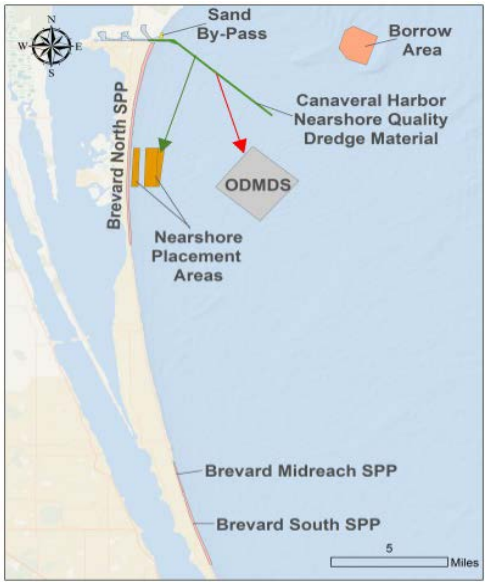


Figure 84. Map of Canaveral Harbor nearshore quality material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 37.

offshore borrow area and as a result, increases the nourishment interval from six to eight years and lowers the annual cost of the combined strategy by $1.1 million to $3.2 million.

The South Reach SPP is nourished approximately every six years and no RSM opportunities were identified.

Table 37. Summary of Costs and Value of Beach-quality Material for Projects at Canaveral Harbor and Brevard County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Canaveral Harbor to ODMDS	3	$10	150,000	$0.9	$1.5	$3.9	$1.3
RSM 1	Canaveral Harbor to Brevard North Reach	3	$10	150,000	$0.9	$1.5	$3.9	$1.3
							Potential RSM Value Strategy 1:	$0.0
	POTENTIAL NAV Benefit A	3	$10	112,500			$1.1	$0.3
	POTENTIAL NAV Benefit B							$1.1
							TOTAL Combined POTENTIAL RSM Value Strategy 1:	**$1.4**
*SPP 1	Offshore Borrow to Brevard North	6	$18	500,000	$1.0	$4.2	$14.2	$2.4
*NAV Mitigation 1	Canaveral Sand bypass to Brevard North	6	$9	500,000	$1.0	$6.0	$11.5	$1.9

Total Combined Potential RSM value for Strategy 1 was calculated by subtracting the cost of the NAV project from the RSM project and adding potential NAV Benefits A and B.
Potential NAV Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.
Potential NAV Benefit B was estimated assuming the RSM project provides 40% of the needed volume to maintain shoreline protection at the SPP from an offshore borrow source (220,000 CY of 520,000 CY every six years). The additional 40% of material would increase the project interval from six to eight and a half years and reduce the annual cost to $3.2 million for a net value of $1.1 million.
*The Brevard North Reach SPP and Sand Bypass (NAV Mitigation) projects alternate every 3 years.

Nearshore-quality Material Placement Strategies

A summary of nearshore-quality material placement strategies, total project costs, and value is provided in Figure 84 and Table 38. Strategies for placement of nearshore-quality material from Canaveral Harbor include placement in the ODMDS or nearshore placement area at a cost of $11/CY. Execution of the RSM 1 strategy for nearshore-quality material could provide an annual value of $0.8 million annually relative to the ODMDS option. The nearshore placement zone is located in 15 – 25 feet of water. Additional effort to place material closer to shore in the active littoral zone could provide additional storm risk reduction for the Brevard North Reach SPP and reduce volume requirements currently provided by sand bypassing and the offshore borrow area. In addition, littoral zone placement areas are reusable as the sediment is transported onshore and along shore between placement events. This strategy would also minimize

volume removed from the offshore borrow area which would likely increase the lifecycle of the authorized offshore borrow source.

Table 38. Summary of Costs and Value of Nearshore-quality Material for Projects at Canaveral Harbor and Brevard County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Canaveral Harbor to ODMDS	3	$11	350,000	$0.9	$1.6	$6.4	$2.1
RSM 1	Canaveral Harbor to Brevard North Nearshore Placement	3	$10	350,000	$0.9	$ 2.0	$6.8	$2.2
							Potential RSM Value Strategy 1:	-$0.1
	Additional POTENTIAL NAV Benefit A	3	$10	260,000			$2.6	$0.9
							TOTAL Combined Potential RSM Value Strategy 1:	**$0.8**

Total combined potential RSM value for Strategy 1 was calculated by subtracting the cost of the NAV project from the RSM project and adding potential NAV Benefit A.
Additional potential NAV Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 times the cost per CY from an offshore borrow source.

Opportunities for Action

A significant amount of material is dredged from the Canaveral Harbor Navigation project that is not suitable for beach or nearshore placement. This material is currently placed in an ODMDS at a cost of $9/CY and may be utilized for environmental benefits. Thin-layer placement of dredge material in shallow, lower energy areas of rivers and estuaries as well as on marshes is a beneficial use gaining interest within the coastal management community. Environmental benefits include promotion of SAV growth and restoring marsh elevations, especially in light of sea level rise. Other potential beneficial uses of dredge material in the project area include filling of relict dredge holes and island habitat creation.

4.4.7 Fort Pierce Harbor and Ft. Pierce Shore Protection Project

Summary

SAJ manages dredge material from the Fort Pierce Harbor NAV Project in an environmentally beneficial and economically efficient manner. SAJ dredges Fort Pierce Harbor every five years and beneficially uses approximately 200,000 CY of beach-quality material on the Fort Pierce SPP. The value of this sediment management strategy is approximately $0.2 million annually to the FRM project (Figure 85). As mitigation for downdrift erosion impacts per Section 111, the Fort Pierce Harbor navigation project is required to pay 60% of the cost for the Fort Pierce SPP. Therefore, the estimated value of $0.2 million was split at $0.1 million for the NAV program and $0.1 million for the FRM program.

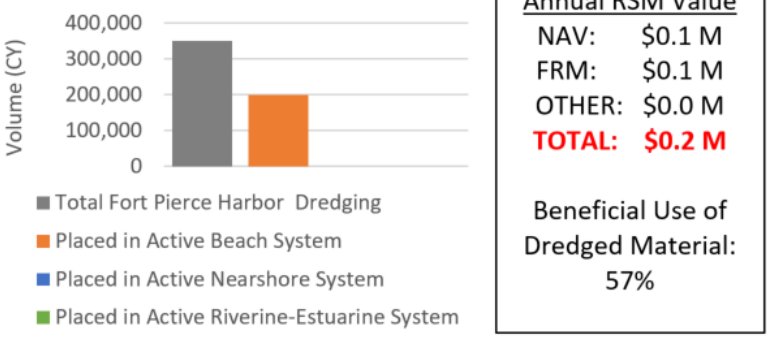


Figure 85. Total volume of sediment dredged from Fort Pierce Harbor per dredge cycle (standard dredge cycle: 5 years). Total annual RSM value is $0.2 million.

Every five years, approximately 150,000 CY of material is dredged from the project that is not suitable for beach or nearshore placement, so it's placed in an ODMDS. Beneficial use of this material for environmental restoration or other uses should be explored.

Introduction

The Fort Pierce Harbor NAV Project is located in St. Lucie County, FL (Figure 86). Approximately 200,000 CY of beach-quality material is dredged every five years from the project. Placement options for dredge material include an ODMDS as well as authorized beach placement immediately south of the harbor at the Fort Pierce SPP. Per state law, beach-quality material is required to be placed on adjacent beaches where feasible. The Fort Pierce SPP requires an estimated 430,000 CY every five years to maintain sufficient storm risk reduction for the project.

Figure 86. Map of Fort Pierce, FL indicating locations of the Fort Pierce Harbor Navigation and SPP projects.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project costs, and value is provided in Figure 87 and Table 39. The relative cost per CY is primarily a function of distance to the placement sites and equipment and effort required for dredging and placement at the individual sites. The project cost for placement of beach-quality material at the ODMDS is approximately $18/CY for a total project cost of $1.0 million annually. The cost of placing sand at the Fort Pierce SPP from the offshore borrow area is $12/CY for a total project cost of $2.0 million annually.

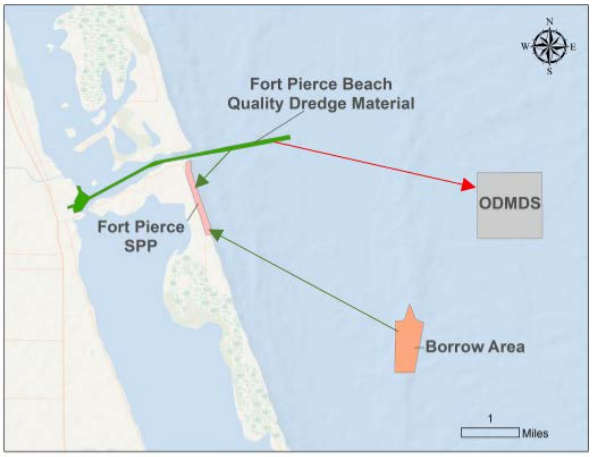


Figure 87. Map of Fort Pierce beach quality material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 39.

SAJ executes the RSM strategy by placing beach-quality material at the Fort Pierce SPP at $15/CY for a total project cost of $1.3 million annually. Placement of approximately 150,000 CY (assuming 25% loss of 200,000 CY initially dredged) of beach-quality material from the navigation project at the Fort Pierce SPP every five years accounts for 30% of the total volume required to maintain storm risk reduction at Fort Pierce SPP. The sand placed on the beach provides an annual value of $0.4 million at no cost to the FRM project. The placement strategy also extends the nourishment interval from four to five years, lowering the annual net cost of the SPP by $0.1 million after accounting for an additional annual $0.3 million in project cost relative to the NAV 1 option. Beach-quality sand resources are extremely limited in southeastern Florida and costs associated with identifying offshore borrow areas are very costly, so all opportunities to conserve current resources should be encouraged.

Nearshore-quality Material Placement Strategies

Fort Pierce Harbor does not contain nearshore-quality dredge material. Hard bottom habitat in the vicinity of the inlet and SPP creates a permitting challenge for nearshore placement.

Opportunities for Action

Approximately 150,000 CY of material is dredged from the Fort Pierce Harbor Navigation project that is not suitable for beach or nearshore placement. This material is currently placed in an ODMDS at a cost of $18/CY and may be utilized for environmental benefits. Thin-layer placement of dredge material in shallow, lower energy areas of rivers and estuaries as well as on marshes is a beneficial use gaining interest within the coastal management community. Environmental benefits include promotion of SAV growth and restoring marsh elevations, especially in light of sea level rise. Fort Pierce Inlet State Park is adjacent to the project and presents an excellent opportunity for thin-layer placement. Other potential beneficial uses of dredge material in the project area include filling of relict dredge holes and island habitat creation.

Table 39. Summary of Costs and Value of Beach-quality Material for Projects at Fort Pierce Harbor and Beach.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Ft. Pierce Harbor to ODMDS	5	$18	200,000	$0.7	$0.8	$5.1	$1.0
SPP 1	Offshore Borrow to Ft. Pierce SPP	4	$12	400,000	$0.9	$2.1	$7.8	$2.0
RSM 1	Ft. Pierce Harbor to Ft. Pierce SPP	5	$15	200,000	$0.7	$2.8	$6.4	$1.3
	NAV and FRM Benefit A	5	$12	150,000			$1.8	$0.4
	NAV and FRM Benefit B							$0.4
							TOTAL Combined RSM Value Strategy 1:	**$0.5**

NAV and FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

NAV and FRM Benefit B was estimated assuming the RSM project provides 30% of the needed volume to maintain shoreline protection at the SPP (120,000 CY of 431,000 CY every four years). The additional 30% of material would increase the project interval from four to five years and reduce the annual cost for a net value of $0.4 million.

Total RSM value of $0.5 million calculated by adding NAV and FRM Benefits A and B and subtracting the additional cost of RSM 1 from NAV 1.

4.4.8 St. Lucie Inlet Navigation Project, Martin County Shore Protection Project, and Intracoastal Waterway – Okeechobee Waterway Crossroads Federal Navigation Projects

Summary

SAJ is currently managing dredged material from the St. Lucie Inlet NAV Project in an environmentally beneficial manner (Figure 88). SAJ beneficially uses beach-quality material by placing it on the beach at the Hobe Sound National Wildlife Refuge (NWR) for a total value of $0.3 million annually to the NWR. As mitigation for downdrift erosion impacts per Section 111, the St. Lucie Inlet navigation project is required to pay 60% of the cost of downdrift impacts. Material currently placed at Hobe Sound NWR helps to account for downdrift impacts and Section 111 mitigation. Per the St. Lucie Inlet Management Plan, beach-quality material must be placed downdrift (south) of the inlet. The beach-quality material could be utilized by the federal Martin County SPP at Hutchinson Island, which would directly benefit a federal SPP and provide $0.8 million in annual value by combining the NAV and FRM projects.

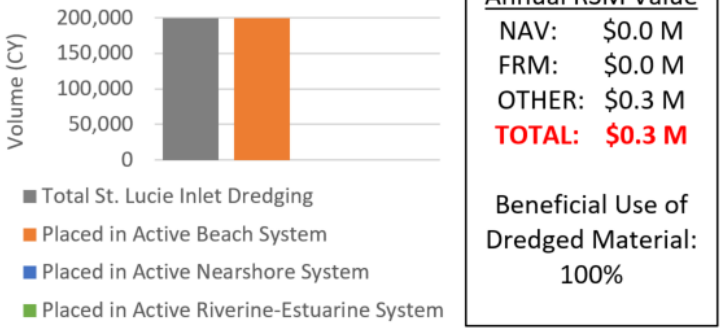


Figure 88. Total volume of sediment regularly dredged from St. Lucie Inlet per dredge cycle (standard dredging cycle: 3 years). Total annual RSM value is $0.3 million.

Beach-quality material is periodically dredged from the IWW and Okeechobee Waterway (OWW) projects and is placed at Hobe Sound NWR and smaller volumes are placed at the St. Lucie Sediment Impoundment Basin (north side of St. Lucie Inlet) (Figure 89). Placement at Hobe Sound NWR provides critical environmental habitat for nesting birds and turtles. Placement at St. Lucie Sediment Impoundment Basin is the cheapest option for placement of beach-quality sand and allows for Martin County to redistribute sand along the beach to the north of the inlet, as needed. Dredging is periodically funded by the non-federal sponsor (Martin County), and in these instances, preference is given to the non-federal sponsor's desired placement areas.

Figure 89. Map of St. Lucie Inlet, FL indicating locations of interest and the Martin County SPP.

Introduction

The St. Lucie Navigation Project is located in Martin County. The Martin County SPP is located to the north of the Inlet and Hobe Sound NWR is located to the south of the inlet (Figure 89). Beach-quality material is dredged from the inlet and from the IWW and OWW. Placement options for dredge material

include a standard DMMA and ODMDS, as well as authorized rehandling, beach, and nearshore placement areas associated with the Martin County SPP and Hobe Sound NWR.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 90 and Table 40. The relative cost per CY is primarily a function of distance to the placement sites and equipment and effort required for placement at the individual sites. The project cost for placement of beach-quality material at the ODMDS is approximately $21/CY for a total project cost of $6.3 million every three years (NAV 1). The cost of placing sand at the Martin County SPP from the offshore borrow area is $20/CY for a total project cost of $1.6 million annually (SPP 1). RSM strategies 1 and 2 (placement at and Martin County SPP and Hobe Sound NWR beach, respectively) are cheaper per CY than ODMDS placement, but mobilization estimates were significantly more expensive than the offshore placement option. Additional effort to reduce mobilization costs for the RSM strategies could make the RSM options the least-cost placement option.

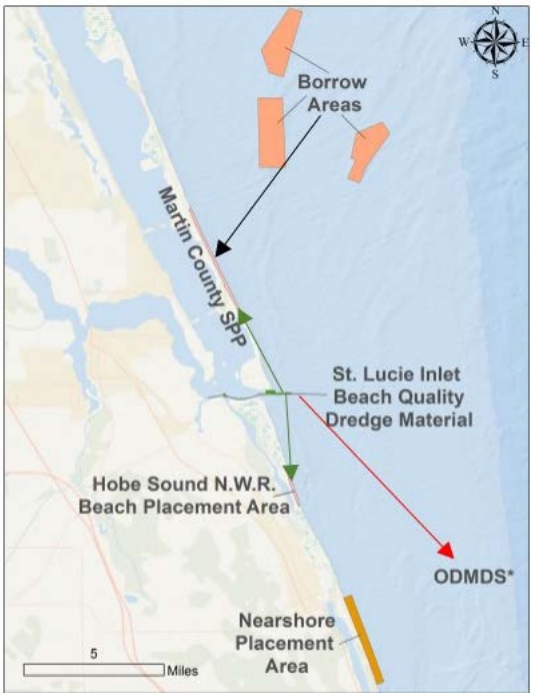


Figure 90. Map of St. Lucie Inlet and beach quality material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 40.

**No ODMDS permitted for St. Lucie Inlet. Cost estimate assumes ODMDS is 6 miles from inlet which is consistent with adjacent projects.*

Placement of beach-quality material at Martin County SPP could provide a net annual value of $0.8 million by providing 200,000 CY of sand to the FRM project and accounting for 22% of the sand required every 11 years. Placement of St. Lucie Inlet beach-quality dredged material at Martin County SPP provides additional benefits, such as conserving scarce sand resources at offshore borrow areas. Placement at Hobe Sound NWR provides $0.3 million in annual value in the form of sand on the beach for the Fish and Wildlife Service, which enhances environmental habitat for sea turtles and birds in addition to recreational usage. Per State of Florida regulations, beach-quality material should be placed on the beach when feasible. The RSM federal preference would be to place beach-quality material north of the inlet at the Martin County SPP as it provides additional value relative to the currently implemented RSM 2 strategy. However, per the St. Lucie Inlet Management Plan, beach-quality sand shall be placed downdrift of the inlet at Hobe Sound. Beach-quality sand resources are limited in southeastern Florida and expenses associated with identifying offshore borrow areas are very costly, so all opportunities to conserve current resources should be encouraged.

Additional placement opportunities, such as placement at a borrow area or the St. Lucie Sediment Impoundment Basin, are the cheapest placement options per CY, but require a second project to beneficially place material on the beach or in the active littoral zone. Placement in the impoundment basin is beneficial to USACE as it reduces dredging costs and is beneficial to Martin County as they are able to easily distribute the dredged material as needed around St. Lucie Inlet to maintain critical habitat and protect infrastructure.

Nearshore-quality Material Placement Strategies

St. Lucie Inlet does not contain nearshore-quality dredge material. Hard bottom habitat in the vicinity of the inlet creates a permitting challenge for nearshore placement.

Opportunities for Action

All dredged material from St. Lucie Inlet is beneficially used.

Table 40. Summary of Costs and Value of Beach-quality Material for Projects at St. Lucie Inlet and Martin County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	St. Lucie Inlet to ODMDS	3	$21	200,000	$0.4	$1.7	$6.3	$2.1
SPP 1	Offshore Borrow to Martin Co SPP	11	$20	660,000	$2.0	$2.7	$17.9	$1.6
NON-RSM 1	Combined Traditional NAV and SPP Projects							$3.7
RSM 1	St. Lucie Inlet to Martin Co SPP Beach	3	$15	200,000	$0.4	$4.3	$7.7	$2.6
	POTENTIAL RSM 1 NAV and FRM Benefit A	3	$20	150,000			$3.0	$1.0
	POTENTIAL RSM 1 NAV and FRM Benefit B							$0.3
							TOTAL COMBINED POTENTIAL RSM Value Strategy 1:	**$0.8**
RSM 2	St. Lucie Inlet to Hope Sound NWR Beach	3	$18	200,000	$0.4	$4.3	$8.3	$2.8
	RSM 2 OTHER Benefit A	3	$20	150,000			$3.0	$1.0
							TOTAL COMBINED RSM Value Strategy 2:	**$0.3**
RSM 3	St. Lucie Inlet to Martin Co SPP Nearshore	3	$15	200,000	$0.4	$4.3	$7.7	$2.6
RSM 4	St. Lucie Inlet to Rehandling Area	3	$12	200,000	$0.4	$2.3	$5.1	$1.7
RSM 5	St. Lucie Inlet to Borrow Area	3	$15	200,000	$0.4	$4.3	$7.7	$2.6
NAV 2	St. Lucie Inlet to DMMA	3	$16	200,000	$0.4	$0.5	$4.1	$1.4

Total combined potential RSM value for Strategy 1 was calculated by subtracting the cost of the combined NAV 1 and SPP 1 projects from the RSM project and adding potential RSM 1 NAV and FRM Benefits A and B.

Potential RSM 1 NAV and FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

Potential RSM 1 NAV and FRM Benefit B was estimated assuming the RSM project provides 23% of the needed volume to maintain shoreline protection at the SPP (150,000 CY of 660,000 CY every eleven years). The additional 23% of material would increase the project interval from eleven to thirteen years and reduce the annual cost to $1.0 million for a net value of $0.3 million.

Total combined RSM value for Strategy 2 was calculated by subtracting the cost of the NAV project from the RSM project and adding RSM 2 OTHER Benefit A.

RSM 2 OTHER Benefit A was estimated based on the volume of sand placed on the beach from RSM 2 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

[$]Placement at the Rehandling Area (small green box on north side of channel adjacent to beach in Figure 90) has been used for small projects (IWW-OWW Crossroads) and material is re-used by Martin County for beach placement. Limited capacity restricts use for larger dredging projects.

Note: NAV and FRM benefits split 60-40 per Section 111 mitigation.

4.4.9 Jupiter Intracoastal Waterway Federal Navigation Project and Palm Beach County Jupiter-Carlin Shore Protection Project

Summary

SAJ is currently managing beach-quality dredged material from the Jupiter IWW and Jupiter-Carlin SPP in an environmentally and economically beneficial manner (Figure 91). SAJ beneficially uses beach-quality material from Jupiter IWW by placing it on the Jupiter-Carlin SPP, immediately south of the dredging site. The value of this sediment management strategy is approximately $0.9 million annually to the FRM program at no cost to the NAV program. The implemented RSM project is the only economically feasible option as upland placement of the material is prohibitively expensive and offshore placement is not practical as the shallow draft channel limits the size of available dredges to remove material and place offshore. Additional effort to coordinate dredging of Jupiter IWW with the Jupiter-Carlin SPP could significantly lengthen the beach nourishment interval at the Jupiter-Carlin SPP and reduce combined project cost.

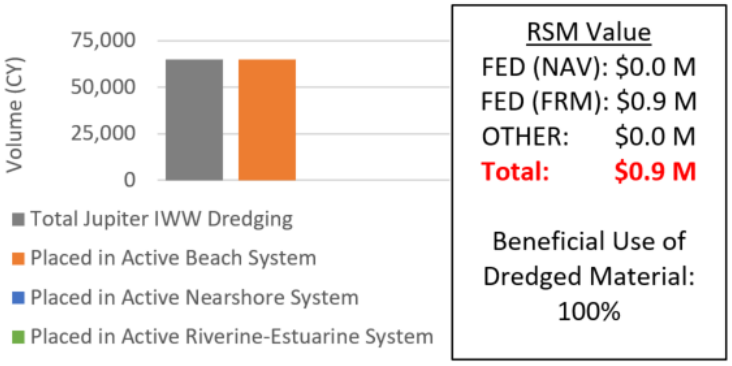


Figure 91. Total volume of sediment regularly dredged from Jupiter IWW per dredge cycle (standard dredging cycle: 4 years). Total annual RSM value is $0.9 million.

Introduction

The Jupiter IWW Navigation Project and Jupiter-Carlin SPP are located in south Florida along the Atlantic Ocean in Palm Beach County (Figure 92). Beach-quality material is located in the project channel and placed on the downdrift beach. DMMA and ODMDS options are prohibitively expensive. SAJ recently nourished Jupiter-Carlin SPP as part of the 2013 FCCE Act. The beach was nourished with material from adjacent offshore borrow sites. Nearshore sediment resources and upland placement options are very limited in south Florida and all opportunities to beneficially use dredged material should be explored.

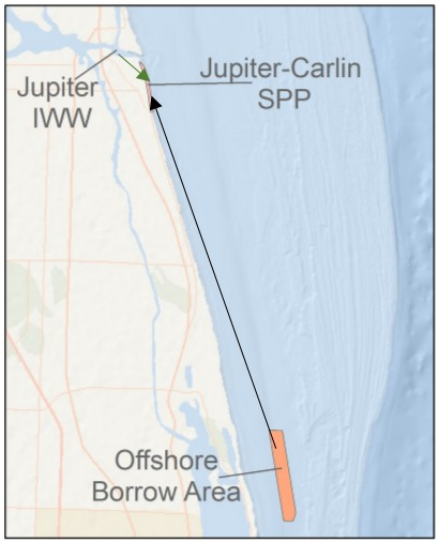


Figure 92. Map of Jupiter IWW and Jupiter-Carlin SPP. strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 41.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 92 and Table 41. The relative cost per CY is primarily a function of distance to the placement sites and equipment and effort required for placement at the individual sites.

Jupiter IWW is dredged every four years and material is placed immediately downdrift of Jupiter Inlet at a cost of $12/CY (RSM 1). Based on the cost to place material from an offshore borrow area to the Jupiter-Carlin SPP, this RSM strategy provides $0.4 million of annual value. Additional calculated value is based on the assumption that the additional material provides 15% of the volume required to maintain shoreline protection, which provides the lifecycle benefit of increasing the placement interval from six to seven years and decreases annual cost to $2.8 million annually for a value of $0.5 million. Additional effort to coordinate dredging of Jupiter IWW with the Jupiter-Carlin SPP could significantly lengthen the beach nourishment interval at Jupiter-Carlin SPP and minimize mobilization and dredging costs.

Table 41. Summary of Costs and Value of Beach-quality Material for Projects at Jupiter IWW and Palm Beach County Jupiter-Carlin SPP.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
SPP 1	Offshore Borrow to Jupiter-Carlin Beach	6	$30	500,000	$1.5	$3.5	$20.0	$3.3
RSM 1	Jupiter IWW to Downdrift Beach (Jupiter-Carlin)	4	$11	65,000	$0.4	$3.3	$4.5	$1.1
	FRM Benefit A	4	$27	50,000			$1.5	$0.4
	FRM Benefit B							$0.5
							RSM Value Strategy 1:	**$0.9**

RSM value for Strategy 1 was calculated by adding FRM Benefits A and B.
FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.
FRM Benefit B was estimated assuming the RSM project provides 15% of the needed volume to maintain shoreline protection at the SPP (75,000 CY of 513,000 CY every six years). The additional 15% of material would increase the project interval from six to seven years for a net value of $0.5 million.

Nearshore-quality Material Placement Strategies

Jupiter IWW does not contain nearshore-quality dredge material. There is a finite template available for nearshore placement due to hard bottom habitat in the vicinity of the inlet and SPP.

Opportunities for Action

All dredged material from Jupiter IWW is beneficially placed on the beach.

4.4.10 Palm Beach Harbor Federal Navigation Project and Palm Beach County Shore Protection Projects

Summary

SAJ is currently managing dredged material from the Palm Beach Harbor (PBH) NAV Project in an environmentally and economically beneficial manner. SAJ beneficially uses beach-quality material by placing material from PBH at Midtown nearshore, immediately south of PBH. The net RSM value of this sediment management strategy is <$100,000 annually (Figure 93) but it is important to ensure proper management of downdrift impacts at Palm Beach Harbor and Midtown in order to proactively maintain a healthy system and preclude the need for mandated mitigation.

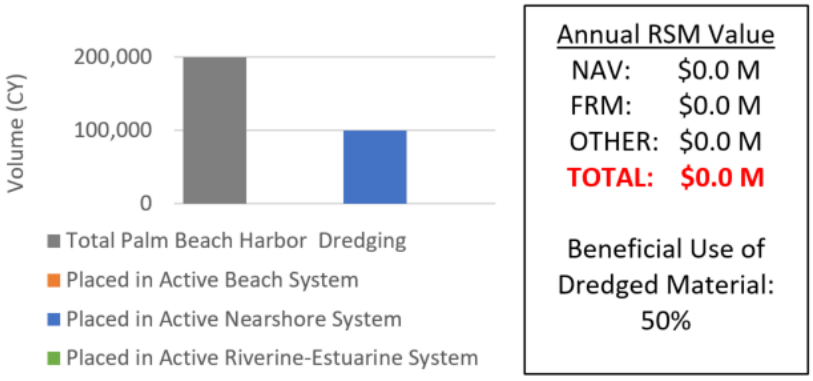


Figure 93. Total volume of sediment dredged from Palm Beach Harbor per dredge cycle (standard dredge cycle: 2 years).

Introduction

The PBH Navigation Project is located in south Florida along the Atlantic Ocean in Palm Beach County (Figure 94, Figure 95). Beach-quality material is located in the project channel and placement areas include authorized beach and nearshore areas as well as DMMA and ODMDS options. SAJ recently nourished Jupiter-Carlin, Ocean Ridge, Delray, and North Boca Raton beaches as part of the 2013 FCCE Act. Each beach was nourished with material from adjacent offshore borrow sites. Nearshore sediment resources and upland placement options are very limited in south Florida and all opportunities to beneficially use dredged material should be explored.

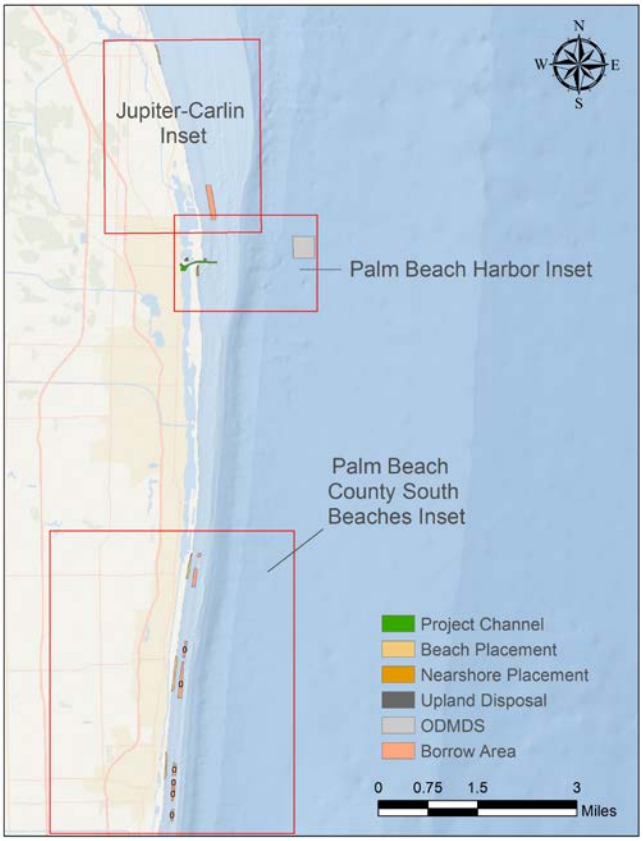


Figure 94. Map of Palm Beach County, FL indicating sites associated with Palm Beach Harbor and SPPs. See Figure 95 for detailed inset maps.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 95 and Table 42. The relative cost per CY is primarily a function of distance to the placement sites and equipment and effort required for placement at the individual sites. The project cost for placement of beach-quality material from PBH at the ODMDS is approximately $11/CY for a total project cost of $1.4 million annually (NAV 1). The cost of placing sand at the Midtown nearshore site from PBH is $14/CY for a total project cost of $1.8 million annually (RSM 1). Midtown is an authorized federal project but has not been constructed. The shore protection benefits were estimated at $0.4 million annually assuming a cost per CY of $11 (average of 3 SPPs in Table 42 per CY from offshore sources). Net value was estimated at <$0.1 million annually after subtracting the difference in the ODMDS and nearshore placement costs. Reduction of mobilization costs for nearshore or beach placement could allow for direct value to the NAV program without combining FRM and NAV business lines to achieve net positive value.

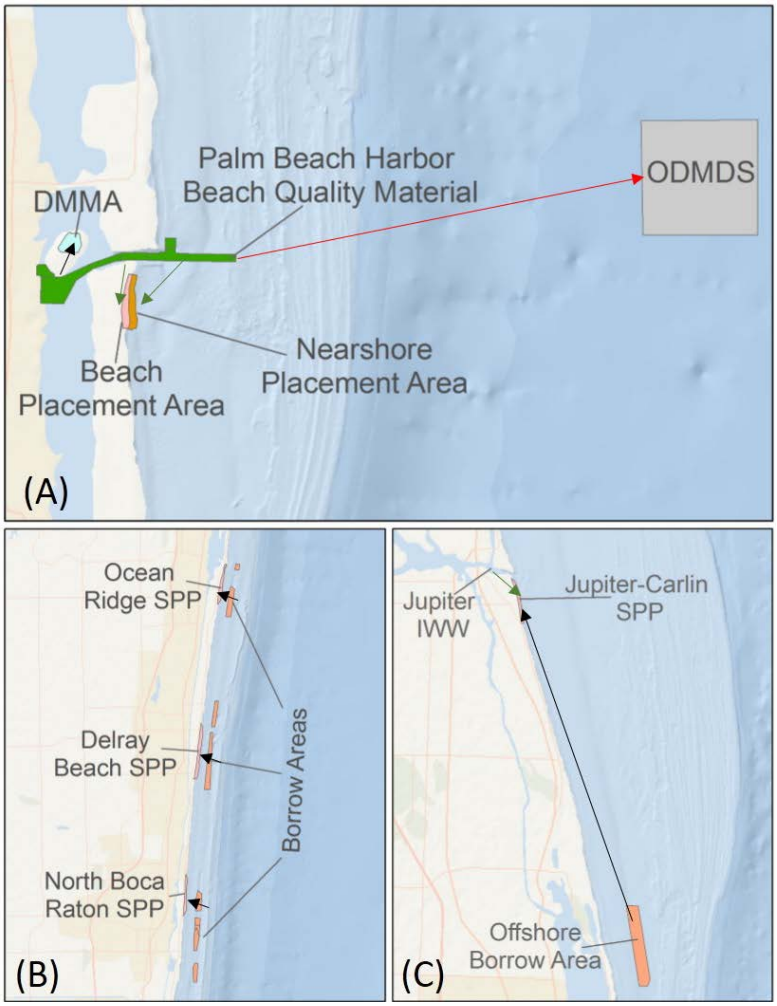


Figure 95. Map of Palm Beach County Navigation and SPP projects at: (A) Palm Beach Harbor, (B) Palm Beach County South Beaches, and (C) Jupiter-Carlin. See Figure 94 inset locations for reference. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 42.

SAJ is currently exploring beach placement opportunities at Midtown. The cost of placement on the beach is estimated to be equal to the nearshore placement cost, but beach placement could minimize potential impacts to nearshore reef communities and provide more direct shore protection benefits. Care must be taken to ensure unsuitable material is not placed on beach or in nearshore environment. The beach placement strategy minimizes the potential for sediments to be mobilized back into the navigation channel. Cost associated with placement of beach-quality material from PBH to the four federal SPP projects was estimated at approximately $14/CY.

Table 42. Summary of Costs and Value of Beach-quality Material for Projects at Palm Beach Harbor and Palm Beach County SPPs.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Palm Beach Harbor to ODMDS	2	$11	100,000	$1.0	$0.6	$2.7	$1.4
RSM 1	Palm Beach Harbor to Midtown Reach 1,2 Nearshore	2	$14	100,000	$1.0	$1.1	$3.5	$1.8
	OTHER Benefit A	2	$11	75,000			$0.8	$0.4
						RSM Value Strategy 1:		**$0.01**
SPP 1	Offshore Borrow to Ocean Ridge Beach	6	$10	500,000	$1.5	$3.8	$10.3	$1.7
SPP 2	Offshore Borrow to Delray Beach	6	$11	400,000	$1.5	$3.8	$9.6	$1.6
SPP 3	PBC SPP North Boca	6	$11	600,000	$1.5	$3.8	$12.0	$2.0

RSM value for Strategy 1 was calculated by subtracting the cost of the NAV project from the RSM project and adding OTHER Benefit A. OTHER Benefit A was estimated based on the volume of sand placed in the nearshore from RSM 1 times the cost per CY from an offshore borrow source.

Table 43. Summary of Costs and Value of Other Material for Project at Palm Beach Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Palm Beach Harbor to ODMDS	2	$10	100,000	$1.0	$0.5	$2.5	$1.3
NAV 2	Palm Beach Harbor to DMMA	2	$16	100,000	$1.0	$3.3	$5.9	$3.0
RSM 1	Palm Beach Harbor to Lake Worth Lagoon (fill dredge holes)	2	$30	100,000	$1.0	$3.5	$7.5	$3.8

Opportunities for Action

Approximately 100,000 of material is dredged from PBH every other year that is not suitable for beach or nearshore placement (Table 43). The cost to place the material at the ODMDS is $10/CY. SAJ conducted a study to estimate the cost of filling dredge holes in Lake Worth Lagoon from PBH dredge material, but determined it was not a feasible option for placement based on cost (RSM 1). Other potential beneficial uses of dredge material in the project area include filling of relict dredge holes closer to PBH and island habitat creation. The Peanut Island recreation area, located on the island that houses the PBH DMMA (Figure 95A), is an example of a successful RSM project in PBH.

4.4.11 Broward Intracoastal Waterway Federal Navigation Project and Broward County Segment II Shore Protection Project

Summary

SAJ is currently managing beach-quality dredged material from Broward IWW NAV Project at Hillsboro Inlet in an economically beneficial manner (Figure 96). SAJ beneficially uses beach-quality material from Hillsboro Inlet by placing material on Hillsboro Inlet Beach, the northern most section of the Broward County Segment II SPP. Placement on the beach is the lowest cost placement option and provides an estimated $0.9 million of annual value to the Broward County Segment II SPP, the federal project south of Hillsboro Inlet, at no additional cost to USACE or local/state partners. Dredging of Broward County IWW at Hillsboro Inlet could be coordinated with beach nourishment at Broward County Segment II SPP to conserve resources and save additional money.

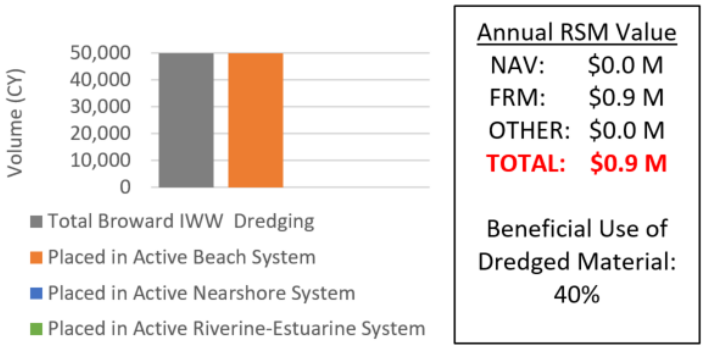


Figure 96. Total volume of sediment dredged from Broward IWW at Hillsboro Inlet per dredge cycle (standard dredge cycle: 5 years). Total annual RSM value is $0.9 million.

Introduction

The Broward County IWW NAV Project and Broward County Segment II SPP are located in south Florida along the Atlantic Ocean in Broward County (Figure 97). Placement of beach-quality material for Segment II is authorized between R-25 and R-72. SAJ recently nourished Broward Segment II from R-27 to R-53 with an upland sand source as part of the 2013 FCCE Act. Nearshore sediment resources and upland placement options are very limited in south Florida and all opportunities to beneficially use dredged material should be explored.

Figure 97. Map of Broward IWW and Broward Segment II SPP. RSM strategy are indicated by green arrow that correspond with highlighted strategy and value identified in Table 44.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 97 and Table 44.

The relative cost per CY is primarily a function of sand availability, distance to the placement sites, and equipment and effort required for placement at the individual sites.

Broward IWW at Hillsboro Inlet is dredged approximately every five years and material is placed immediately downdrift of the inlet on the Broward Segment II SPP at Hillsboro Inlet Beach at a cost of $17/CY (RSM 1). Beach placement is the only economically feasible placement option as upland and offshore placement are prohibitively expensive. The benefit of the dredged beach-quality sand to the downdrift beach is $0.5 million annually based on the cost per CY of beach-quality sand from an upland source for the Broward Segment II SPP. By providing 40% of the sand needed to maintain shoreline protection at Broward Segment II from the NAV project, the nourishment interval for the SPP is increased from seven to ten years which reduces the annual cost to $1.0 million and provides $0.4 million in value.

Table 44. Summary of Costs and Value of Beach-quality Material for Projects at Broward IWW and Broward County Segment II SPP.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
*SPP 1	Upland Borrow to Broward Seg II	7	$65	130,000	$1.5	$0	$9.6	$1.4
RSM 1	Broward IWW to Hillsboro Inlet Beach (Broward Seg II)	5	$17	50,000	$0.4	$4.2	$5.5	$1.1
	FRM Benefit A	5	$65	38,000			$2.4	$0.5
	FRM Benefit B							$0.4
							RSM Value Strategy 1:	**$0.9**

RSM value for Strategy 1 was calculated by adding FRM Benefits A and B.
FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an upland borrow source.
FRM Benefit B was estimated assuming the RSM project provides 40% of the needed volume to maintain shoreline protection at the SPP (53,000 CY of 130,000 CY every six years). The additional 40% of material would increase the project interval from six to ten years and reduce the annual cost to $1.0 million for a net value of $0.4 million.
*Volume associated with only the northern component of Broward Segment II maintained by USACE.

Nearshore-quality Material Placement Strategies

Broward IWW does not contain nearshore-quality dredge material.

4.4.12 Port Everglades Harbor Federal Navigation Project and Broward County Shore Protection Projects

Summary

SAJ manages dredged material from the Port Everglades Harbor (PEH) NAV Project (Figure 98). SAJ is currently planning to beneficially use beach-quality material from PEH by placing material at Dr. Von D. Mizell-Eula Johnson State Park within the Broward County Segment III SPP footprint. Placement on the beach is a more expensive option than ODMDS placement but is a cheaper source of beach-quality sand for the SPP relative to upland and offshore sources.

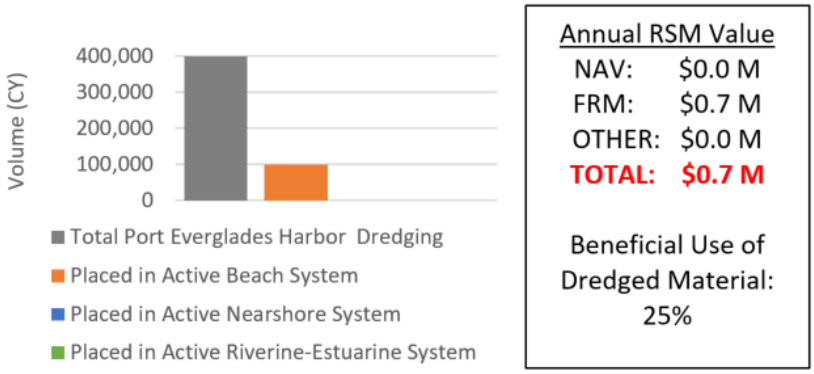


Figure 98. Total volume of sediment dredged from Port Everglades Harbor per dredge cycle (standard dredge cycle: 7 years). Total annual RSM value is $0.7 million.

Considering the very high price of sand in south Florida, placement of dredged material from PEH onto Broward Segment III could provide a value of $0.7 million annually based on an estimate of $32/CY of sand from an offshore borrow source. Upland sand was used for a recent project at Broward Segment II at a cost of $65/CY. Considering the potential value to the FRM program, managers, and USACE should consider coordinating NAV and FRM projects at Broward County to conserve resources and save money; SAJ is currently developing plans for this. During the FY13 dredging at PEH, the Jacksonville District coordinated with the sponsor who contributed the funds in excess of the federal standard so beach-quality material could be placed on Broward County beaches. This is a good example of coordination with stakeholders to implement RSM approaches.

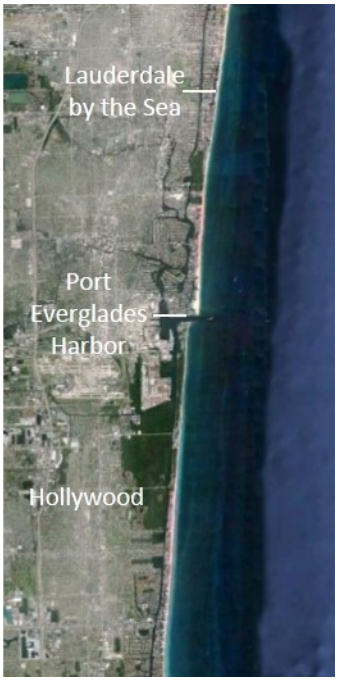


Figure 99. Map of Port Everglades Harbor and coastal Broward County.

Introduction

The PEH NAV and Broward County SPPs are located in south Florida along the Atlantic Ocean in Broward County (Figure 99). PEH is the largest Florida Atlantic coast port in terms of total tonnage, is ranked 32nd nationally in tonnage, and is the second busiest cruise port in the world based on multi-day passengers. SAJ recently nourished Broward Segment II from an upland sand source as part of the 2013 Flood Control and Coastal Emergencies (FCCE) Act. Nearshore sediment resources and upland placement options are limited in south Florida and all opportunities to beneficially use dredged material should be explored.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 100 and Table 45. The relative cost per CY is primarily a function of distance to the placement sites and equipment and effort required for placement at the individual sites. The project cost for placement of all material at the ODMDS is approximately $12/CY for a total project cost of $9.4 million every seven years (NAV 1).

Beach-quality sand is scarce in south Florida and the estimated cost per CY to place sand on the Broward Segment II and III SPPs is $32 and $65 from offshore and upland borrow sources (SPP 1), respectively. The cost of placing beach-quality material from PEH to either of the Broward SPP projects is estimated at $18/CY (RSM 1). While placement of dredged material on the SPP is more expensive than placement at the ODMDS, the cost of using dredged material as a source of sand for the SPP is much cheaper than the available upland or offshore options and conserves very scarce resources.

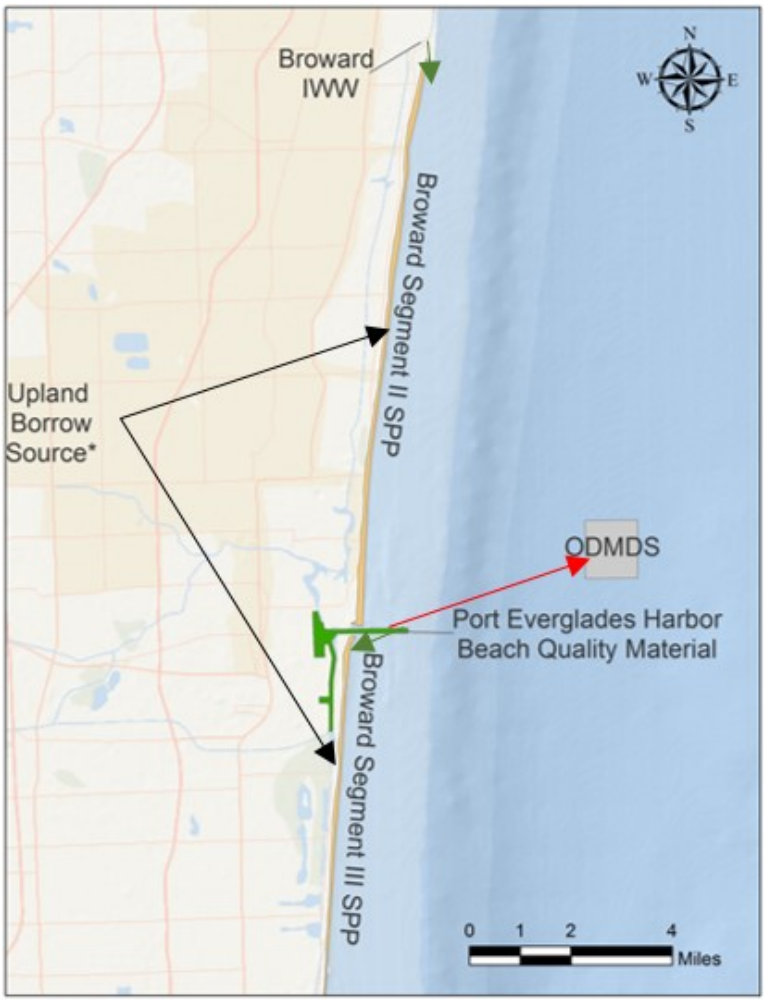


Figure 100. Map of Port Everglades Harbor, Broward IWW, and Broward Segment II and III SPPs. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 45.

**Note: Upland borrow source is located beyond the extent of the figure and label placement on figure is for reference only.*

PEH dredged material primarily consists of beach-quality sand, but some shell and rock is present. Considering the potential value to the FRM program, managers should consider coordinating NAV and FRM projects at Broward County to conserve resources and save money.

Table 45. Summary of Costs and Value of Beach-quality Material for Projects at Port Everglades Harbor and Broward II/III SPPs.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Port Everglades Harbor to ODMDS	7	$12	400,000	$0.6	$4.0	$9.4	$1.3
SPP 1	*Offshore Borrow to Broward III Beach	6	$32	800,000	$1.0	$7.0	$33.6	$5.6
RSM 1	Port Everglades Harbor to Broward II Beach	7	$18	100,000	$0.6	$4.0	$6.4	$0.9
	Potential FRM Benefit A	7	$32	75,000			$2.4	$0.3
	Potential FRM Benefit B							$0.4
							Total POTENTIAL RSM Value Strategy 1:	**$0.7**

Total potential RSM value for Strategy 1 was calculated adding potential FRM Benefits A and B.
FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.
FRM Benefit B was estimated assuming the RSM project provides 8% of the needed volume to maintain shoreline protection at the SPP (64,000 CY of 780,000 CY every six years). The additional 8% of material would increase the project interval from six to six and a half years and reduce the annual cost for a net value of $0.4 million.
*Offshore sand source is limited and unsustainable. Upland borrow source cost estimated at $65/CY.

Nearshore-quality Material Placement Strategies

PEH does not contain nearshore-quality dredge material.

Opportunities for Action

While the majority of dredged material from PEH is beach-quality material, shells and rock are present. Care must be taken to ensure unsuitable material is not placed on the beach. Shell and rock material could be used to support development of nearshore habitat or other environmental uses.

4.4.13 Miami Harbor Navigation, Bakers Haulover Intracoastal Waterway Navigation, and Dade County Shore Protection Projects

Summary

SAJ is managing dredged material from the Miami Harbor NAV Project, Bakers Haulover and the Dade County Beach Erosion Control and Hurricane Protection Project (BEC&HPP) in an environmentally and economically efficient manner. Miami Harbor was deepened in 2015 and the dredging interval for maintenance of the harbor is approximately every ten years. The Bal Harbor segment receives approximately 250,000 CY of sand for beach nourishment every five years from the ebb shoal at Bakers Haulover. Approximately 50,000 CY of beach-quality material is dredged from Bakers Haulover every four years as part of O&M dredging and is placed on the beach at Bal Harbour.

The combination of using sand from the ebb shoal and navigation channel at Bakers Haulover as source material for the Bal Harbour segment of the Dade County BEC&HPP provides a value of $4.1 million annually to the FRM program at no additional cost to the NAV program (Figure 101). Based on the high cost of beach-quality sand in south Florida, opportunities for beneficial use of all beach-quality dredged material should be explored extensively.

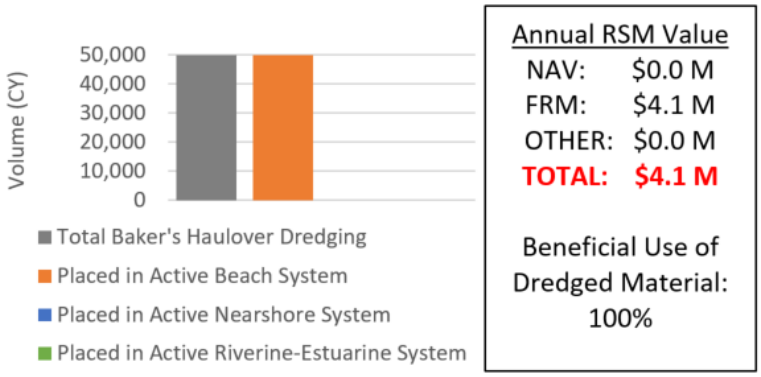


Figure 101. Total volume of sediment dredged from Bakers Haulover per dredge cycle (standard dredge cycle: 5 years). Dredge volume for Miami Harbor not included in estimates due to 10-year dredging interval and recent project deepening. Total annual RSM value is $4.1 million.

Introduction

The Miami Harbor and Bakers Haulover NAV projects and the Dade County BEC&HPP and Sunny Isles are located in south Florida on the Atlantic Ocean (Figure 102). The Miami Harbor deepening project was completed in late 2015. Shoaling rates at Miami Harbor are low and dredging is generally required on the order

Figure 102. Map of Dade County, Florida indicating locations of interest.

of every 10 years. Dredged material is generally not suitable for beach or nearshore placement and is placed at an ODMDS or rock disposal site.

Bakers Haulover is a shallow draft inlet north of Miami Harbor that is dredged approximately every four years and beach-quality dredged material is placed south of the inlet along the Bal Harbour segment. The Bal Harbour segment requires approximately 250,000 CY of sand every five years to maintain adequate shore protection. Coastal structures were installed at the Sunny Isles segment approximately 15 years ago, which have significantly reduced erosion rates and increased the beach nourishment interval from five years to ten years.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 103 and Table 46. The relative cost per CY is primarily a function of distance to the placement sites and equipment and effort required for dredging and placement at the sites.

The ebb shoal at Bakers Haulover is used as a borrow area for the Bal Harbour segment (RSM 1) and provides an annual value of $3.2 million relative to an upland sand source (SPP 1, 2). Use of material from the ebb shoal promotes the efficient, cost-effective, and beneficial use of material in the littoral system.

Bakers Haulover is dredged approximately every four years and material is placed immediately downdrift of the inlet at Bal Harbour SPP at a cost of $18/CY (RSM 2) and provides approximately 15% of the needed sand to maintain adequate storm protection at Bal Harbour. Beach placement is the only economically feasible placement option as upland and offshore placement would be significantly more expensive.

The value of the beach-quality material placed on Bal Harbour from O&M dredging is

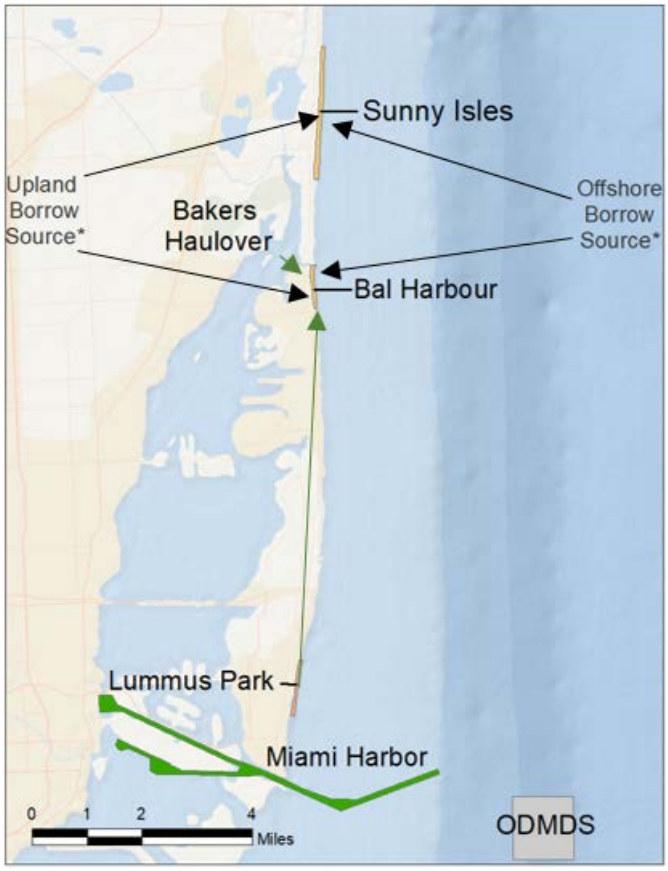


Figure 103. Map of Dade County RSM strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 46.

**Note: Upland borrow source is located beyond the extent of the figure and offshore borrow source locations vary. Label placement on figure for upland and offshore borrow sources is for reference only.*

approximately $0.4 million annually relative to the cost of placement from an upland borrow source. An additional $0.5 million of annual value is calculated from the dredged O&M material that provides 15% of the sand needed to maintain shoreline protection and increases the nourishment interval from five to five and three-quarter years, reducing the annual cost. Lummus Park and the beach immediately north of Miami Harbor contain large quantities of beach-quality sand that has been used to address adjacent erosion hotspots on county beaches, but is not economically or socially feasible to use as a sand source for Bal Harbour or Sunny Isles due to distance and the amount of potential disruption to beach users. Economically efficient RSM opportunities were not identified for the Sunny Isles SPP.

Table 46. Summary of Costs and Value of Beach-quality Material for Projects at Dade County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
SPP 1	Offshore Borrow to Dade County - Bal Harbour Beach	5	$43	300,000	$1.0	$5.3	$19.2	$3.8
SPP 2	Upland Borrow to Dade County - Bal Harbour Beach	5	$80	300,000	$1.0	$0	$25.0	$5.0
RSM 1	Bakers Haulover Ebb Shoal to Dade County - Bal Harbour	5	$18	225,000	$1.0	$4.1	$9.2	$1.8
							RSM Value Strategy 1:	**$3.2**
*RSM 2	Bakers Haulover Channel to Bal Harbour Beach	4	$18	50,000	$0.4	$2.0	$3.3	$0.8
	RSM 2 FRM Benefit A	4	$41	37,500			$1.5	$0.4
	RSM 2 FRM Benefit B							0.5
							TOTAL RSM Value Strategy 2:	**$0.9**
							TOTAL COMBINED RSM Value Strategy 1 and 2:	**$4.1**
RSM 3	Lummus Park Beach to Dade County - Bal Harbour Beach	5	$34	1,100,000	$1.0	$7.2	$45.3	$9.1
SPP 3	Offshore Borrow to Dade County - Sunny Isles Beach	10	$43	300,000	$1.3	$5.3	$20.3	$2.0
SPP 4	Upland Borrow to Dade County - Sunny Isles Beach	10	$80	300,000	$1.3	$0	$25.3	$2.5

RSM value for Strategy 1 was calculated by subtracting the cost of the NAV project from the RSM project.
RSM value for Strategy 2 was calculated by adding RSM 2 FRM Benefits A and B.
RSM 2 FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an upland borrow source.
RSM 2 FRM Benefit B was estimated assuming the RSM project provides 15% of the needed volume to maintain shoreline protection at the SPP (42,000 CY of 275,000 CY every five years). The additional 15% of material would increase the project interval from five to five and three-quarters years and reduce the annual cost (relative to RSM 1 annual project cost) for a net value of $0.5 million.
*O&M project completed in 2014.

Nearshore-quality Material Placement Strategies

Miami Harbor and Bakers Haulover do not contain nearshore-quality dredge material.

Opportunities for Action

While Miami Harbor is only dredged every ten years and contains rock, opportunities for beneficial use of the dredged material are available. Recently, SAJ placed 560,000 CY of dredged material from the deepening of Miami Harbor in a dredge hole north of the harbor, creating over 15 acres of seagrass habitat. The dredged material was capped with 85,000 CY of select fill and planted with native seagrasses. Due to the scarcity and expense of sand in south Florida, innovative methods to retain sand on the beaches, especially at erosion hotspots, should be explored. The Bal Harbour NAV project could be investigated as a borrow source which could provide advance maintenance benefits to the NAV program.

4.4.14 Pinellas County Shore Protection Projects and Shallow Draft Navigation Projects

Summary

SAJ manages dredged material from shallow draft NAV projects at Clearwater Pass, Johns Pass, and Pass-a-Grille in an environmentally and economically efficient manner. Sand from the shallow draft projects in combination with sand from offshore sources and Egmont Shoals is used to maintain adequate shoreline protection for the Pinellas County SPP. The Pinellas County project includes areas at Sand Key, Treasure Island, and Long Key.

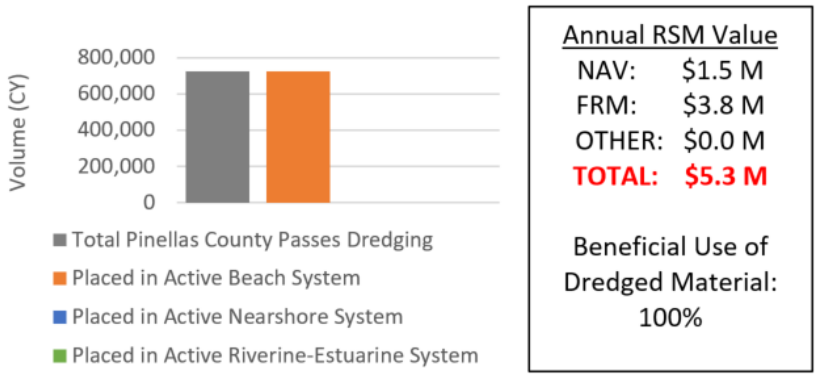


Figure 104. Total volume of sediment regularly dredged from shallow draft inlets and passes in Pinellas County (estimated dredge cycles: Clearwater Pass–5 years; John's Pass and Pass-a-Grille–10 years). Total annual RSM value is $5.3 million.

Approximately 725,000 CY is dredged from the shallow draft projects and is placed on the SPPs for a total value of $5.3 million annually (Figure 104). The value to the NAV program is $1.5 million relative to placement at an ODMDS or DMMA and $3.8 million in value to the FRM program - a result of the cheaper price of the shallow draft sand relative to an offshore or Egmont Shoals source.

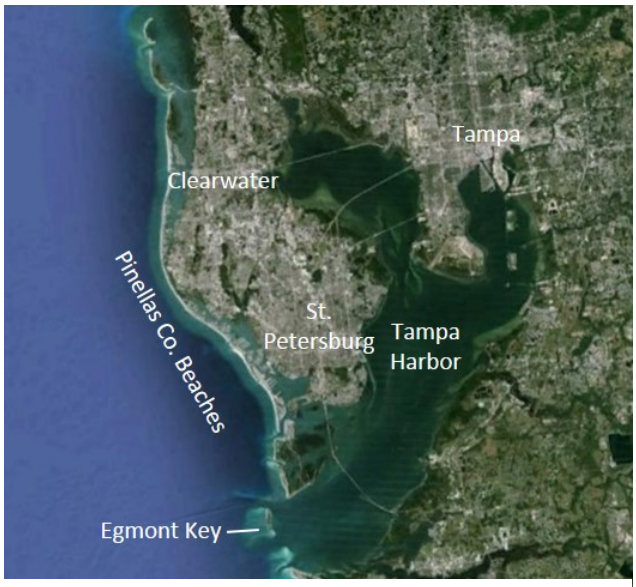


Figure 105. Map of the Tampa Bay region indicating locations of interest for navigation and shore protection projects.

Introduction

The Pinellas County SPP has three areas (Sand Key, Treasure Island, and Long Key) with four passes/inlets (Clearwater Pass, Johns Pass, Blind Pass, Pass-A-Grille) adjacent to the project that contain beach-quality sand (Figure 105). The shallow draft inlets are dredged every five to ten years and the sand is placed on adjacent beaches. Estimated quantities to maintain adequate shoreline protection for Sand Key, Treasure Island, and Long Key are 105,000 CY/year, 65,000

CY/year, and 50,000 CY/year, respectively. SAJ and Pinellas County use a combination of shallow draft passes, offshore borrow sources, and Egmont Shoals as sand sources for the Pinellas County SPP.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs for Pinellas County SPP and shallow draft NAV projects in Pinellas County is provided in Figure 106 and Table 47.

Due to the cost of placement at the Tampa ODMDS and DMMA sites, the RSM strategy of placing beach-quality material at Long Key, Treasure Island, and Sand Key are the most economical placement options for the dredged material which is consistent with RSM principles.

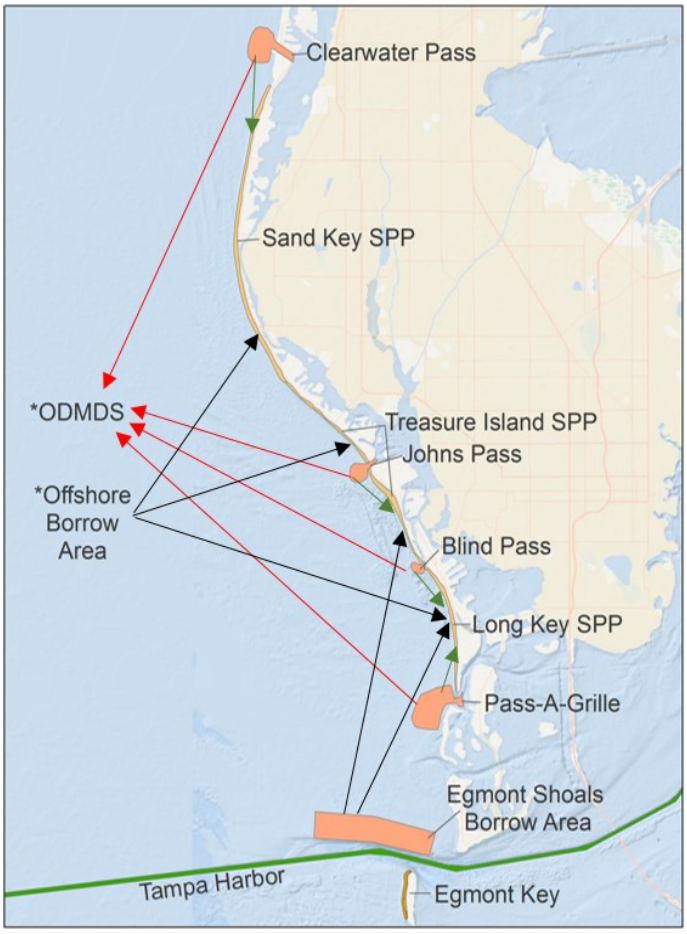


Figure 106. Map of Pinellas County beach quality dredged material RSM strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 47.

**Note: Multiple offshore borrow areas are authorized for Pinellas County. The offshore borrow areas and the Tampa ODMDS are located beyond the extent of the figure. Locations for each are for general reference only.*

Sand Key can utilize sand from offshore ($27/CY) and Clearwater Pass ($11/CY) to maintain adequate shore protection benefits. The cost of placing material from Clearwater Pass on Sand Key is $11/CY (RSM 1) and placement at the ODMDS is $25/CY (NAV 1). While the offshore sand source is generally a cheaper option for beach-quality sand relative to Egmont Shoals, Clearwater Pass provides the greatest value from both a NAV and FRM perspective. Implementation of RSM 1 provides a value of $0.7 million annually to the NAV program and $1.8 to the FRM program for a total value of $2.5 million annually. Placement of approximately 150,000 CY (assuming 25% loss of 200,000 CY initially dredged) of beach-quality material from Clearwater Pass at Sand Key every five years accounts for 30% of the total volume required to maintain sufficient storm risk reduction at Sand Key. The sand placed on the beach provides an annual value of $0.8 million at no cost to the FRM project and extends the nourishment interval from five to six and a half years, lowering the annual cost of the SPP by $1.0 million.

Sand resources for Treasure Island include offshore and Egmont Shoals options at $24 and $28 per CY (SPP 2, RSM 2), respectively, as well as John's Pass at an estimated cost of $13/CY (RSM 3). While there

is no economic value associated with RSM Strategy 2, implementation of RSM 3 (Johns Pass as source for Treasure Island) provides an average annual value of $1.5 million ($0.4 million to NAV and $1.1 million to FRM). Johns Pass provides approximately 30% of the total volume required to maintain sufficient storm risk reduction at Treasure Island. The sand placed on the beach provides an annual value of $0.5 million at no cost to the FRM project and extends the nourishment interval from five to six and a half years, lowering the annual cost of the SPP by $0.6 million.

Sand resources for the Long Key SPP include offshore and Egmont Shoals options at $24 and $16 per CY (SPP 3, RSM 4), respectively, as well as the shallow draft project at Blind Pass ($12/CY; RSM 5) and Pass-a-Grille ($14/CY; RSM 6). The value of using Egmont Shoals as a borrow area source for Long Key is $0.4 million annually relative to the offshore option. The value of RSM strategy 5, placement of sand from the Blind Pass channel, is $0.5 million split between NAV and FRM at $0.2 and $0.3 million per year, respectively. The value beach-quality sand placed on Long Key from Pass-a-Grille (RSM 6) is $0.4 million per year split equally between NAV and FRM.

Opportunities for Action

All dredged material from the Pinellas County NAV projects is placed beneficially. Long Key could potentially use nearshore-quality material dredged from Tampa Harbor to account for the majority of sand needed to maintain adequate shoreline protection. Additional environmental planning would be required to ensure nearshore hard bottom environments or other environmentally sensitive areas are not impacted.

Table 47. Summary of Costs and Value of Beach-quality Material for Projects in Pinellas County.

SAND KEY

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
SPP 1	Offshore Borrow to Sand Key SPP	5	$27	525,000	$1.5	$5.8	$21.5	$4.3
NAV 1	Clearwater Pass to ODMDS	5	$25	200,000	$0.4	$2.3	$7.7	$1.5
RSM 1	Clearwater Pass to Sand Key Beach	5	$11	200,000	$0.4	$1.6	$4.2	$0.8
							RSM Value Strategy 1:	$0.7
	FRM Benefit A	5	$27	150,000			$4.1	$0.8
	FRM Benefit B							$1.0
							TOTAL Combined RSM Value Strategy 1:	**$2.5**

Total combined RSM value for Strategy 1 was calculated by subtracting the cost of the NAV project from the RSM project and adding FRM Benefits A and B.

FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

FRM Benefit B was estimated assuming the RSM project provides 30% of the needed volume to maintain shoreline protection at the SPP (150,000 CY of 525,000 CY every five years). The additional 30% of material would increase the project interval from five to six and a half years and reduce the annual cost to $6.5 million for a net value of $1.0 million.

TREASURE ISLAND

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
SPP 2	Offshore Borrow to TI SPP	5	$24	325,000	$0.7	$5.8	$13.7	$2.7
RSM 2	Egmont Shoals to TI SPP	5	$28	325,000	$0.7	$5.8	$15.0	$3.0
							RSM Value Strategy 2:	$-0.3
NAV 2	Johns Pass to ODMDS	10	$25	275,000	$0.4	$2.3	$9.6	$1.0
RSM 3	Johns Pass to TI Beach	10	$13	275,000	$0.4	$1.6	$5.6	$0.6
							RSM Value Strategy 3:	$0.4
	RSM 3 FRM Benefit A	10	$24	205,000			$5.0	$0.5
	RSM 3 FRM Benefit B							$0.6
							TOTAL Combined RSM Value Strategy 4:	**$1.5**

Total combined RSM value for Strategy 3 was calculated by subtracting the cost of the NAV project from the RSM project and adding FRM Benefits A and B.

RSM 3 FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 3 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

RSM 3 FRM Benefit B was estimated assuming the RSM project provides 31% of the needed volume to maintain shoreline protection at the SPP (103,000 CY of 325,000 CY every five years). The additional 30% of material would increase the project interval from five to 6.5 years and reduce the annual cost to $2.1 million for a net value of $0.6 million.

LONG KEY

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
SPP 3	Offshore Borrow to Long Key SPP	5	$24	250,000	$0.5	$5.8	$12.3	$2.5
RSM 4	Egmont Shoals to Long Key SPP	5	$16	250,000	$0.5	$5.8	$10.3	$2.1
							RSM Value Strategy 4:	$0.4
NAV 3	Blind Pass to ODMDS	10	$25	150,000	$0.4	$2.3	$6.5	$0.6
RSM 5	Blind Pass to Long Key Beaches	10	$12	150,000	$0.4	$1.6	$3.8	$0.4
							RSM Value Strategy 5:	$0.2
	RSM 5 FRM Benefit A	10	$24	112,500			$2.7	$0.3
							TOTAL Combined RSM Value Strategy 5:	$0.5
NAV 4	Pass-a-Grille to ODMDS	10	$25	100,000	$0.4	$2.3	$5.2	$0.5
RSM 6	Pass-a-Grille to Long Key Beaches	10	$14	100,000	$0.4	$1.6	$3.4	$0.3
							RSM Value Strategy 6:	$0.2
	RSM 6 FRM Benefit A	10	$24	75,000			$1.8	$0.2
							Total Combined RSM Value Strategy 6:	$0.4
							TOTAL Combined RSM Value Strategies 4 - 6:	**$1.3**

RSM value for Strategy 4 was calculated by subtracting the cost of the RSM project from the SPP project.
RSM value for Strategy 5 was calculated by subtracting the cost of the RSM project from the NAV project and adding FRM Benefit A.
RSM 5 FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 5 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

4.4.15 Tampa Harbor Navigation Project

Summary

SAJ manages dredged material from the Tampa Harbor in an environmentally and economically efficient manner. Approximately 1,000,000 CY of nearshore-quality material is dredged from Tampa Harbor every five years. Beneficial use of the material provides $1.7 million of annual value to the NAV program and an additional $3.6 million annually to Egmont Key State Park (Figure 107). Placement of the material at the Pinellas County (Long Key) SPP could provide the same value to the FRM program. Nearshore hard bottom habitat may limit nearshore placement opportunities at Long Key and Treasure Island. The material could also be placed at Fort Desoto, a Pinellas County Park, at the same value to the county.

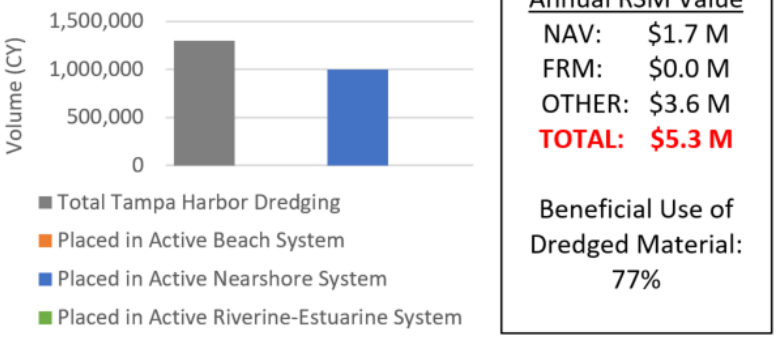


Figure 107. Total volume of sediment regularly dredged from Tampa Harbor (standard dredge cycle: 1 year). Total annual RSM value is $5.3 million.

**Depending on placement strategy, value of $3.6 million annually is attributed to either FRM (if placed at Long Key SPP) or Other (Egmont Key, Fort Desoto), not both.*

Approximately 300,000 CY of dredged material consisting of mud, silt, and clay is dredged from Tampa Harbor annually; 1,000,000 CY of nearshore quality material dredged approximately every five years. With permission from the Florida Department of Environmental Protection (FDEP), SAJ recently placed material with silt content higher than recommended per FDEP regulations at Egmont Key to determine if placement of material with higher silt content is feasible at this location. SAJ has used dredged material with high silt and clay content for environmental restoration purposes such as filling in relict dredge holes (MacDill Hole, McKay Bay), developing sea grass habitat, and continues to explore this opportunity in partnership with non-government organizations (NGOs) and resource agencies in the region.

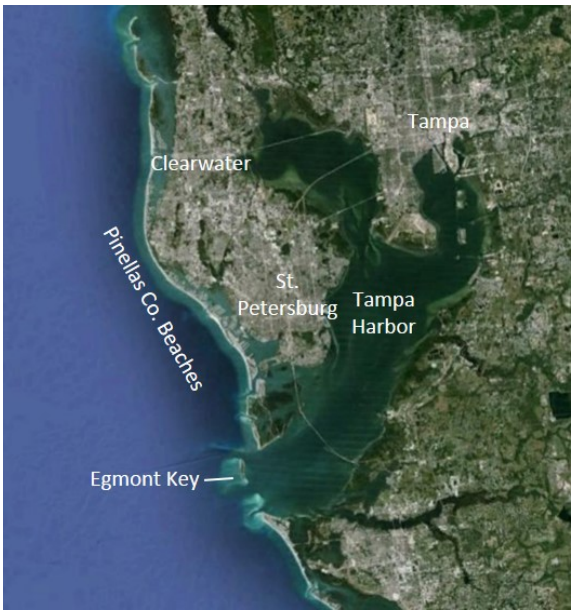


Figure 108. Map of the Tampa Bay region indicating locations of interest for navigation and shore protection projects.

Introduction

The Tampa Bay region is home to three deep draft harbors (Tampa Harbor, Manatee Harbor, and St. Petersburg Harbor) (Figure 108). Tampa Harbor supports nearly 80,000 jobs and provides $15 billion

in annual economic impact (Port Tampa Bay, 2016). Approximately 300,000 CY is dredged annually from Tampa Harbor. Nearshore-quality material is located in the entrance channel and is dredged every five years. USACE recently placed nearshore-quality material on the beach and nearshore areas of Egmont Key (listed on the National Register of Historic Places and managed by U.S. Fish and Wildlife Service and Florida State Parks) in Tampa Harbor that hosts a lighthouse and fort as well as other cultural and environmental resources. Studies to assess the fate of finer grain material and relative differences of using siltier material on the beach than generally accepted are on-going. Initial data suggests siltier material is transported downslope and off the beach.

Nearshore-quality Material Placement Strategies

A summary of nearshore-quality material placement strategies and total project costs for Tampa Harbor is provided in Figure 109 and Table 48. Nearshore-quality material is dredged from Tampa Harbor every five years. Due to the cost of placement at the Tampa ODMDS and DMMA sites, the RSM strategy of placing the nearshore-quality material at nearshore areas of Long Key, Treasure Island, Egmont Key, or Fort Desoto are the most economical placement options which also keeps the sediment in the active littoral system. The cost of placement in the nearshore at Long Key/Treasure Island or Egmont Key beach was estimated at $15/CY (RSM 1, 2), and placement at the Tampa ODMDS was estimated at $25/CY (NAV 1).

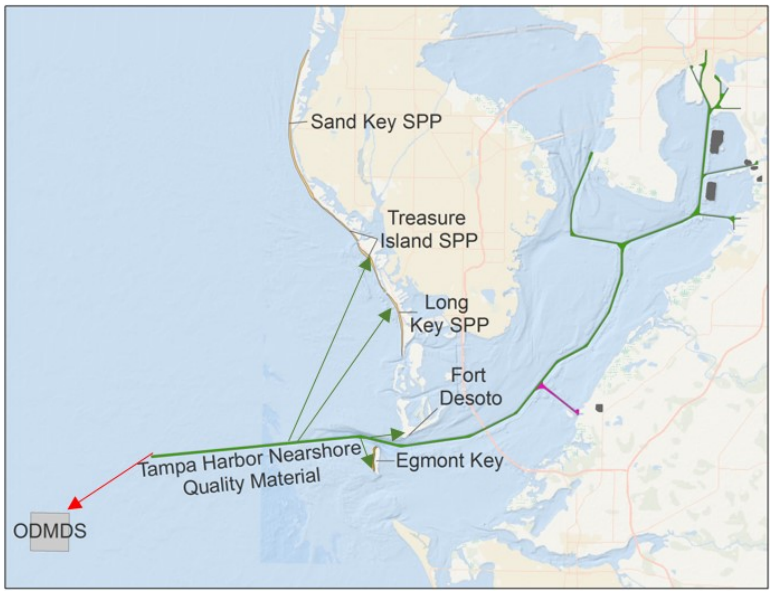


Figure 109. Map of Tampa Bay nearshore quality dredged material RSM strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 48.

**Note: Tampa ODMDS is located beyond the extent of the figure. Location is for general reference only.*

The total value of placement at any of the identified RSM strategies is $5.3 million annually with $1.7 million attributed to the NAV program and $3.6 million attributed to the FRM program (Pinellas County SPP) or state parks at Egmont Key or Fort Desoto. Mobilization costs associated with dredging and placement of nearshore-quality material for the defined RSM strategies are high relative to ODMDS placement ($3.5 million versus $2.3 million) and significant value could be realized by dredge optimization and focused effort to reduce mobilization costs for the Tampa Harbor and Pinellas County projects. Placement at Long Key and Treasure Island should be prioritized as they are part of a federal SPP. Placement at Egmont Key has been successfully executed in the past while placement in the

nearshore areas of the SPP would require additional coordination and care to ensure hard bottom habitats and environmentally sensitive areas are not impacted.

Table 48. Summary of Costs and Value of Nearshore-quality Material for Projects at Tampa Harbor and Pinellas County SPPs.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Tampa Harbor to ODMDS	5	$25	1,000,000	$1.6	$2.3	$28.7	$5.7
*RSM 1	Tampa Harbor to Long Key-Treasure Island Nearshore	5	$15	1,000,000	$1.6	$3.5	$20.1	$4.0
							RSM Value Strategy 1:	$1.7
	Potential RSM 1 FRM Benefit	5	$24	750,000			$18.0	$3.6
							TOTAL Combined RSM Value Strategy 1:	**$5.3**
RSM 2	Tampa Harbor to Egmont Key Beach	5	$15	1,000,000	$1.6	$3.5	$19.8	$4.0
RSM 3	Tampa Harbor to Egmont Key Nearshore	5	$15	1,000,000	$1.6	$3.5	$19.8	$4.0
RSM 4	Tampa Harbor to Fort Desoto	5	$15	1,000,000	$1.6	$3.5	$19.8	$4.0
							RSM Value Strategy 2-4:	$1.7
	RSM 2-4 OTHER Benefit	5	$20	750,000			$15.0	$3.6
							TOTAL Combined RSM Value Strategy 2-4:	**$5.2**

RSM value for strategies 1-4 were calculated by subtracting the cost of the NAV project from the RSM project and adding FRM or OTHER Benefits. FRM Benefits were estimated based on the volume of sand placed on the beach from the RSM strategy (assuming 25% loss during placement) times the cost per CY from an offshore borrow source for adjacent project at Long Key.
*Implementation of RSM Strategy 1 may not be feasible due to nearshore hard bottom environments.

Opportunities for Action

Significant value could be realized by dredge optimization and focused efforts to reduce mobilization costs for Tampa Harbor and Pinellas County projects. Other material consisting of silt, mud, and clay is dredged from Tampa Harbor every year (Table 49). Placement options for Tampa Harbor material include Tampa ODMDS at $27/CY and DMMAs at $25/CY. Opportunities for beneficial use of the Tampa Harbor dredged material include placement at Egmont Key nearshore, filling of dredge holes, or creating seagrass habitat. Numerous dredge holes are located throughout Tampa Bay and projects to fill dredge holes and develop sea grass habitat have proven successful at improving water quality and wildlife habitat in Tampa Bay.

Table 49. Summary of Costs and Value of Other Material for Project at Tampa Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Tampa Harbor to DMMA	1	$25	300,000	$1.6	$3.4	$5.0	$5.0

4.4.16 Manatee Harbor Navigation Project

Summary

SAJ manages dredged material from the Manatee Harbor NAV project in Tampa Bay. Approximately 300,000 CY of mixed sand, silt, clay, limestone, and mud are dredged from Manatee Harbor every three years (Figure 110). All dredged material has been placed in authorized DMMAS since the 1990s.

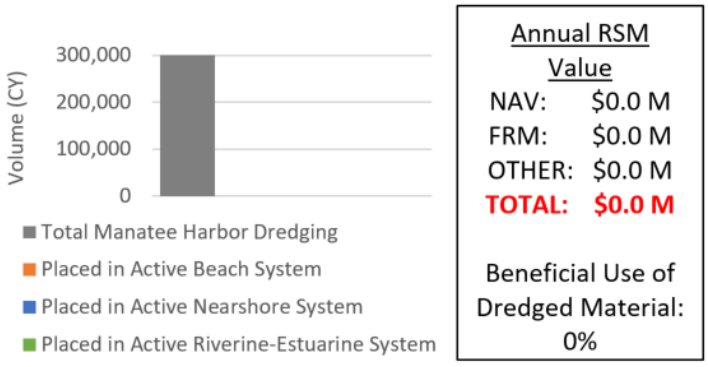


Figure 110. Total volume of sediment regularly dredged from Manatee Harbor (standard dredge cycle: 3 years). Manatee Harbor does not contain beach- or nearshore-quality material. RSM opportunities are currently being explored by SAJ.

The RSM RCX recently analyzed beneficial uses of dredged material strategies including beneficial use offloading, developing wetland habitat adjacent to a historic DMMA, filling dredge holes, and creating hard bottom habitat. The analysis concluded the least-cost long-term sediment management strategy is to offload material to Washington Park where Manatee County will use the material to make a public park. The strategy is a win-win as the Jacksonville District saves money and provides material to the county for public benefit.

Introduction

Manatee Harbor is approximately three miles in length and connects to the Tampa Harbor channel 12 miles from the Egmont Key pilot station (Figure 111). Port Manatee began operations in 1970 and currently occupies 1,100 acres including public warehouse, office, and refrigerated space.

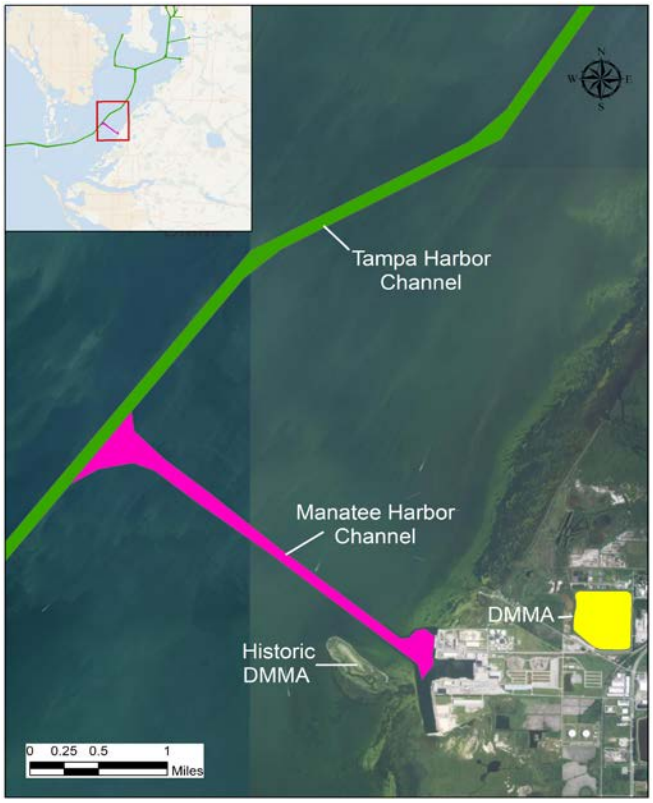


Figure 111. Map of the Manatee Harbor region indicates locations of interest for the navigation project. Federal channel does not include entire port channel. Additional portions of the port channel are maintained by Port Manatee.

Opportunities for Action

Approximately 300,000 CY of mixed sand, silt, mud, and rock material is dredged from Manatee Harbor every three years. The material is placed in the DMMA at a cost of $14/CY (NAV 1). The cost of placing material at

the Tampa ODMDS is $27/CY (NAV 2). The relatively high price is a function of the distance offshore (Table 50).

The RSM RCX recently conducted a lifecycle analysis of dredged material management strategies and determined offloading of DMMA material for beneficial use is the least-cost method for managing dredged material at Manatee Harbor. The Jacksonville District will work with Manatee County to offload dredged material to Washington Park, approximately eight miles from the project site. Washington Park contains several pits of low-grade wetlands and the county will use the material to create a public park using approximately 1 million CY of dredged material. The project is a win-win for the Jacksonville District and the project sponsor, Manatee County, as the Jacksonville District reduces dredged material management costs and provides the county with low cost fill material.

Other opportunities for beneficial use of the Manatee Harbor dredged material include development of wetland habitat adjacent to a historic DMMA (Figure 111), filling dredge holes, and creating hard bottom habitat. Numerous dredge holes are located throughout Tampa Bay and projects to fill dredge holes and develop sea grass habitat have proven successful at improving water quality and wildlife habitat in Tampa Bay. SAJ is currently coordinating with local stakeholders to develop beneficial use options for dredged material from Manatee Harbor.

Table 50. Summary of Costs and Value of Material for Project at Manatee Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Manatee Harbor to DMMA	3	$14	200,000	$0.8	$1.3	$4.9	$1.6
NAV 2	Manatee Harbor to ODMDS	3	$27	350,000	$0.8	$2.3	$12.6	$4.2
RSM 1	Manatee Harbor to fill dredge holes	3	$27	350,000	$0.8	$2.3	$12.6	$4.2

4.4.17 Manatee County

Summary

SAJ manages SPPs as well as irregularly scheduled inlet and Gulf Intracoastal Waterway (GIWW) projects in Manatee County, FL. The Anna Maria Island SPP requires approximately 900,000 CY of beach-quality material every ten years to maintain adequate storm protection and could utilize sand from the Passage Key inlet and ebb shoal as a borrow source at no additional cost relative to an offshore borrow source. Benefits of this strategy include utilizing sand already in the active nearshore system and helping to maintain safe navigation.

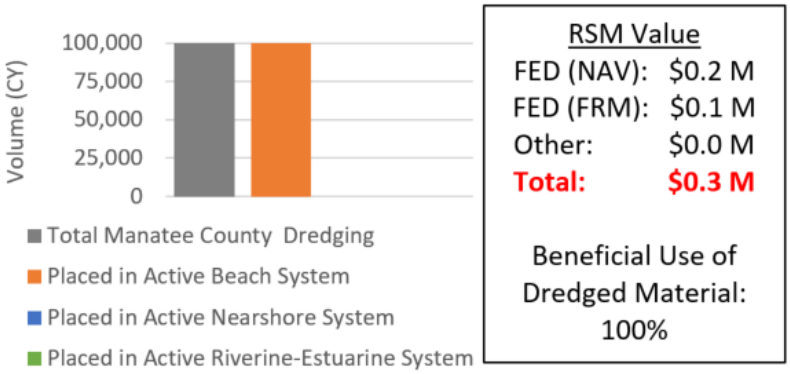


Figure 112. Total volume of sediment regularly dredged from Longboat Pass (standard dredge cycle: 10 years). Total annual RSM value is $0.3 million.

Beach-quality material from Longboat Pass placed at Longboat Key provides approximately $0.2 million in annual value to the NAV program and $0.1 million in annual value to the FRM program (Figure 112) at Longboat Key at no additional cost to USACE or the local sponsor. Value to the NAV program is due to the cheaper placement option at the beach relative to the Tampa ODMDS and value to the FRM program is based on the value of 100,000 CY if placed on the beach from a traditional offshore borrow source.

Introduction

Longboat Pass and Passage Key Inlet are shallow draft NAV projects in Manatee County, FL. Longboat Pass is south of Anna Maria Island and Passage Key Inlet is north of Anna Maria Island (Figure 113). SAJ recently nourished Anna Maria Island with approximately 900,000 CY of sand from an offshore borrow source located 4,000 feet offshore from Passage Key as part of the 2012 Tropical Storm Debbie response.

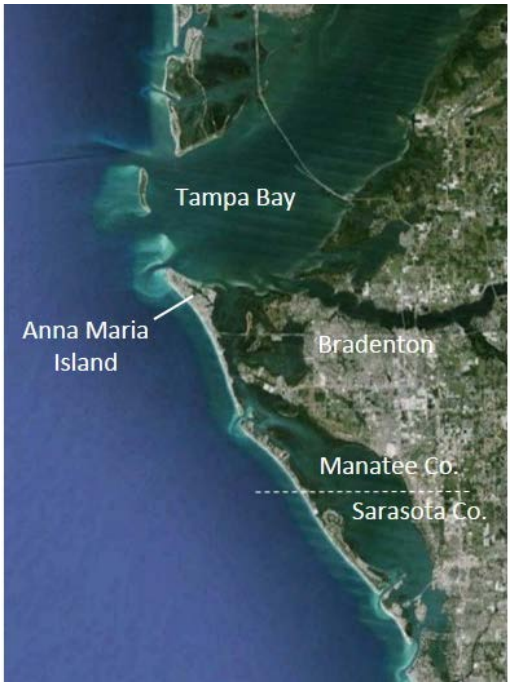


Figure 113. Map of Manatee County, FL indicating locations of interest for navigation and shore protection projects.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 114 and Table 51. The Anna Maria Island SPP receives sand approximately every ten years. The cost of placement from either an offshore borrow source or Passage Key Inlet is estimated at $14/CY with a total annual cost of $1.7 million (RSM 1). While both options are comparable in cost, use of the Passage Key ebb shoal as a sand source is consistent with RSM principles as it utilizes sand already in the nearshore system and supports safe navigation.

Beach-quality material is dredged from Longboat Pass approximately every ten years. Due to the distance to the Tampa ODMDS, the RSM strategy of placing the beach-quality material at Longboat Key Beach (RSM 2) or Bradenton Beach (RSM 3) are the most economical placement options for the dredged material. The estimated cost of placement on Longboat Key Beach was $10/CY; on Bradenton Beach, $13/CY; and at the Tampa ODMDS, $25/CY. The value of the RSM placement strategies relative to the ODMDS option is $0.2 million annually.

Figure 114. Map of Manatee County RSM strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 51.

**Note: Offshore borrow source and Tampa ODMDS are located beyond the extent of the figure.*

Nearshore-quality Material Placement Strategies

Only beach-quality material was identified for Longboat Pass and Passage Key Inlet. Nearshore-quality material is located in the Gulf Intracoastal Waterway and could potentially be placed in nearshore areas associated with the Longboat Key and Bradenton Beach projects.

Table 51. Summary of Costs and Value of Beach-quality Material for Projects at Manatee County.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
SPP 1	Offshore Borrow to Anna Maria Island SPP	10	$14	900,000	$0.9	$3.9	$17.4	$1.7
RSM 1	Passage Key Inlet to Anna Maria Island SPP	10	$14	900,000	$0.9	$3.9	$17.4	$1.7
							RSM Value Strategy 1:	**$-**
NAV 1	Longboat Pass to Tampa ODMDS	10	$25	100,000	$0.4	$2.3	$5.2	$0.5
RSM 2	Longboat Pass to Longboat Key Beach/Nearshore	10	$10	100,000	$0.4	$1.6	$3.0	$0.3
							RSM Value Strategy 2:	**$0.2**
	RSM 2 OTHER Benefit A	10	$14	75,000			$1.0	$0.1
							Total Combined RSM Value Strategy 2:	**$0.3**
RSM 3	Longboat Pass to Bradenton Beach/Nearshore	10	$13	100,000	$0.4	$1.6	$3.3	$0.3
							RSM Value Strategy 3:	**$0.2**
	RSM 3 OTHER Benefit A	10	$14	75,000			$1.0	$0.1
							Total Combined RSM Value Strategy 3:	**$0.3**

RSM value for Strategy 2 and 3 were calculated by subtracting the cost of the NAV project from the RSM project and adding OTHER Benefit A. RSM 2 and 3 OTHER Benefit A was estimated based on the volume of sand placed on the beach from the RSM strategy (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

4.4.18 Venice Beach and Lido Key (Sarasota County) Shore Protection Projects

Summary

SAJ manages SPPs at Lido Key and Venice Beach in Sarasota County. Inlets and passes adjacent to the SPPs provide great opportunities to implement RSM strategies considering the relatively high cost of acquiring offshore beach-quality material to maintain adequate storm protection for the SPPs. Sufficient beach-quality sand resources are available at Big Sarasota Pass and New Pass to nourish Lido Key, which could provide a value of $3.0 million annually to the FRM program relative to traditional offshore sand sources (Figure 115).

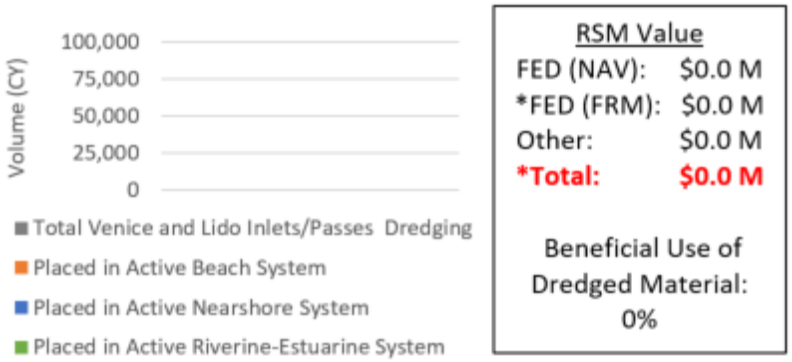


Figure 115. USACE does not routinely dredge shallow draft inlets and passes in the vicinity of SPP projects at Venice Beach or Lido Key. Dredge volumes for FRM projects limited to NAV sources.

While Venice Inlet does not contain enough beach-quality sand to support the entire shore protection needs for the Venice Beach SPP the sand could be used at erosion hotspots to address acute problems and minimize the cost of maintenance between regularly scheduled nourishments. As mitigation for downdrift erosion impacts per Section 111, the Casey's Pass NAV project is required to pay 51% of the cost of downdrift impacts to the Venice Beach SPP. Big Sarasota Pass and New Pass do contain enough sand to supply all needed sand for shoreline protection at Lido Key and could provide a value of $2.6 – $3.0 million annually relative to an offshore borrow source and can serve as a long-term solution to support Lido Key.

Figure 116. Map of Sarasota County, FL indicating locations of interest for RSM projects.

Introduction

The Lido Key and Venice Beach SPPs are located in Sarasota County (Figure 116). SAJ nourished the Venice Beach SPP in FY14. The Lido Key project is currently in the planning stage.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 117 and Table 52. The Venice Beach SPP receives sand approximately every ten years and the Lido Key SPP receives sand approximately every five years. For both projects, beach-quality dredged material from Venice Inlet and New Pass or Big Sarasota Pass are more economically efficient sources of material than offshore borrow areas. While available beach-quality material from Venice Inlet is limited (RSM 1), the sand could be used at erosion hotspots and minimize the cost of maintenance between regularly scheduled nourishments.

Figure 117. Map of Sarasota County RSM strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 52.

The cost of placing sand from Big Sarasota Pass and New Pass onto Lido Key was estimated $9/CY and $8/CY (RSM 2, 3), respectively. The total potential value of using Big Sarasota Pass relative to an offshore borrow area is estimated at $2.6 million annually. Additional beach-quality dredged material from New Pass could be used as an alternative sand source and provides approximately $3.0 million in annual potential value to the FRM program. Strategic utilization of Big Sarasota Pass and New Pass in collaboration with other local and regional stakeholders can provide a long-term solution to sediment resource needs for Sarasota County.

Opportunities for Action

Federal projects described in this fact sheet are limited to SPPs. Analysis of dredged material was limited to beach-quality material available for placement on Venice Beach and Lido Key. While USACE does not routinely dredge shallow draft inlets and passes in the vicinity of SPP projects at Venice Beach or Lido Key, an opportunity exists to begin funding the shallow draft navigation project that provides additional value to the nation by reducing FRM costs. Implementation of these proposed RSM strategies to place dredged beach-quality material on adjacent beaches could provide up to $2.6 - $3.0 million in annual benefits to the Lido Key SPP and maintain navigation channels at no additional cost to the Federal Government.

Table 52. Summary of Costs and Value of Beach-quality Material for Projects at Venice Beach and Lido Key.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
SPP 1	Offshore Borrow to Venice Beach SPP	10	$22	750,000	$2.0	$6.1	$24.6	$2.5
RSM 1	Venice Inlet to North Venice Beach	10	$17	50,000	$0.4	$0.6	$1.8	$0.2
SPP 2	Offshore Borrow to Lido Key Beach	5	$22	750,000	$1.5	$6.1	$24.1	$4.8
RSM 2	Big Sarasota Pass to Lido Key Beach	5	$9	750,000	$1.5	$3.0	$11.3	$2.3
							POTENTIAL RSM Value Strategy 2:	**$2.6**
RSM 3	New Pass to Lido Key Beach	5	$8	600,000	$1.5	$2.9	$9.0	$1.8
							POTENTIAL RSM Value Strategy 3:	**$3.0**

RSM value for Strategy 2 and 3 was calculated by subtracting the cost of the SPP project (2) from the RSM projects.

4.4.19 Gasparilla and Captiva Island (Lee County) Shore Protection Projects

Summary

SAJ manages SPPs at Gasparilla and Captiva Island in Lee County. Inlets and passes adjacent to the SPPs provide great opportunities to implement RSM strategies considering the relatively high cost of acquiring offshore beach-quality material to maintain adequate storm protection for the SPPs. Sufficient beach-quality sand is available in the Boca Grande ebb shoal to nourish the Gasparilla Island SPP. The value of using the shoal and pass as a sand source relative to an offshore source is approximately $0.8 million annually to the FRM program (Figure 118).

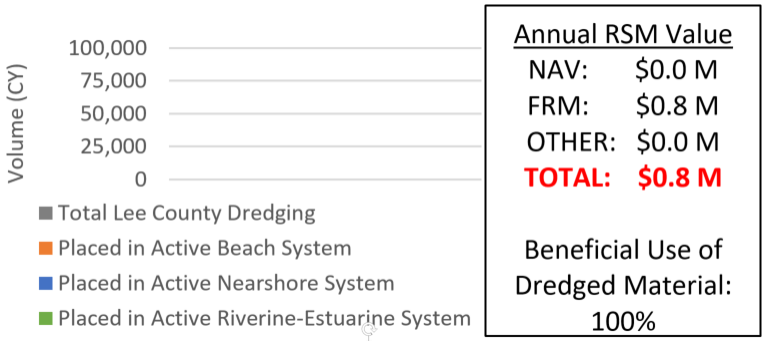


Figure 118. USACE does not routinely dredge shallow draft inlets and passes in the vicinity of SPP projects at Captiva and Gasparilla Islands. Dredge volumes for FRM projects limited to NAV sources. Total annual RSM value is $0.8 million.

Approximately 125,000 CY of beach-quality material is available at Redfish Pass for placement at the Captiva Island SPP which could provide $0.6 million of annual value to the FRM Program. Federal participation in the Captiva Island SPP has been suspended until public access requirements are met.

Introduction

The Captiva Island and Gasparilla Island SPPs are located in Lee County, FL (Figure 119). SAJ recently nourished Gasparilla Island and Venice Beach as part of the 2013 FCCE Act. The Gasparilla Island project nourished the beach between monument R-10 and R-26. The Captiva Island project was not constructed because federal public beach access requirements were not met. Captiva Island was nourished without federal assistance in 2014.

Figure 119. Map of Lee County, FL indicating locations of Gasparilla and Captiva Island projects.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 120 and Table 53. Beach nourishment projects are conducted at Gasparilla Island every seven years and at Captiva Island every eight years. Due to the likely distance to the closest potential offshore borrow area, the RSM strategy of placing the beach-quality material from adjacent inlets is the most economical sand source for the SPPs, and it keeps sediment in the active littoral system. The cost of placing sand from Boca Grande Ebb Shoal onto Gasparilla Island beach was estimated at $17/CY (RSM 1) and placement from an offshore borrow area was estimated at $26/CY (SPP 1). The total value of using the Boca Grande ebb shoal relative to an offshore borrow area is $0.8 million annually.

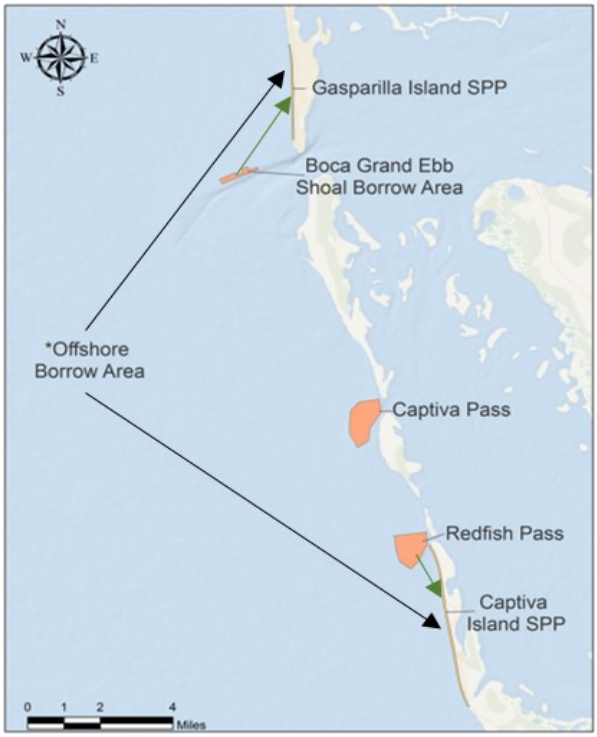


Figure 120. Map of Gasparilla and Captiva Island projects in Lee County. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 53.

**Note: Offshore borrow area is not defined for the Gasparilla Island SPP. Estimate was developed assuming a distance of 8 miles offshore.*

If federal participation in the Captiva Island SPP resumes, utilization of beach-quality sand from Redfish Pass to nourish the beach (RSM 2) is an economically and environmentally beneficial option because it is a cheaper source of beach-quality sand and utilizes sand already in the nearshore system. While Redfish Pass does not contain enough sand to provide all the sand required to maintain adequate shoreline protection at Captiva Island, placement on the beach is cheaper than offshore placement and provides approximately $0.6 million in value to the FRM program. Placement of approximately 94,000 CY (assuming 25% loss of 125,000 CY initially dredged) of beach-quality material from Redfish Pass at the Captiva Island SPP every eight years accounts for 16% of the total volume required to maintain sufficient shoreline protection at Captiva Island. The sand placed on the beach provides an annual value of $0.3 million at no additional cost to the FRM project and extends the nourishment interval from eight to nine years, lowering the annual cost of the SPP by $0.3 million. The dredged sediment can be used at erosion hotspots to address acute problems and minimize the cost of maintenance between regularly scheduled nourishments.

Table 53. Summary of Costs and Value of Beach-quality Material for Projects at Gasparilla and Captiva Islands.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
SPP 1	Offshore Borrow to Gasparilla Beach	7	$26	500,000	$0.8	$4.6	$18.4	$2.6
RSM 1	Boca Grande Ebb Shoal to Gasparilla Beach	7	$17	500,000	$0.8	$3.4	$12.7	$1.8
							RSM Value Strategy 1:	**$0.8**
SPP 2	Offshore Borrow To Captiva Beach	8	$26	600,000	$1.6	$4.6	$21.8	$2.7
RSM 2	Redfish Pass to Captiva Beach	8	$14	125,000	$1.6	$3.9	$7.3	$0.9
	RSM 2 FRM Benefit A	8	$26	94,000			$2.4	$0.3
	RSM 2 FRM Benefit B							$0.3
							POTENTIAL RSM Value Strategy 2:	**$0.6**

RSM value for Strategy 1 was calculated by subtracting the cost of the SPP project from the RSM project.
RSM value for Strategy 2 was calculated by adding RSM 2 FRM Benefits A and B.
RSM 2 FRM Benefit A was estimated based on the volume of sand placed on the beach from RSM 2 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.
RSM 2 FRM Benefit B was estimated assuming the RSM project provides 16% of the needed volume to maintain shoreline protection at the SPP (94,000 CY of 600,000 CY every eight years). The additional 16% of material would increase the project interval from eight to nine years and reduce the annual cost to $2.5 million for a net value of $0.3 million.

Opportunities for Action

Federal projects described in this fact sheets are limited to SPPs. Analysis of dredged material was limited to beach-quality material available for placement on Lee and Sarasota County beaches. While USACE does not routinely dredge shallow draft inlets and passes in the vicinity of the SPP projects, an opportunity exists to begin funding the shallow draft navigation project that provide additional value to the nation by reducing FRM costs. Implementation of these proposed RSM strategies to place dredged beach-quality material on adjacent beaches could provide up to $0.6 million in annual benefits to the Captiva SPP.

4.4.20 Fort Myers Beach, Florida (Matanzas and Estero Pass)

Summary

SAJ manages Fort Myers Inlet for the U.S. Coast Guard Office of Search and Rescue and places nearshore-quality dredged material from Fort Myers Inlet into the nearshore of Fort Myers Beach (Estero Island). Approximately 225,000 CY of nearshore-quality material is dredged material is placed in the nearshore at a value of $1.0 million annually to the NAV program and $1.3 million to the FRM program annually for a total value of $2.3 million (Figure 121).

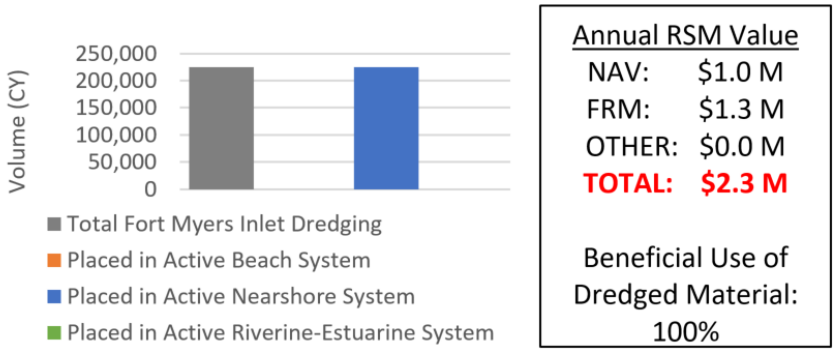


Figure 121. Total volume of sediment regularly dredged from Fort Myers Inlet (standard dredge cycle: 3 years). Total annual RSM value is $2.3 million.

There are no authorized upland or offshore placement options for dredged material at Fort Myers Inlet. Dewatering has been considered but is prohibitively expensive. Nearshore placement is the most cost effective option for dredged material.

Introduction

Fort Myers Inlet is shallow draft NAV project in Lee County, FL (Figure 122). The channel was authorized in 1961 and has been dredged numerous times to maintain navigation. USACE studies that monitored sediment transport from the nearshore berm indicate finer sediments remain in the trough and courser sediments moved onshore. Local offshore placement options for dredged materials have not been established and upland placement options are limited. Local stakeholders would like to develop a Memorandum of Agreement (MOA) to pay the additional cost to take sand further south to address erosion problems.

Figure 122. Map of Fort Myers, FL area indicating locations of interest for the RSM projects.

Nearshore-quality Material Placement Strategies

A summary of nearshore-quality material placement strategies and total project costs for Fort Myers is provided in Figure 123 and Table 54. Nearshore-quality

material is dredged from Fort Myers Inlet approximately every three years. Due to the distance to the closest available ODMDS (Tampa) and expense of upland placement, the RSM strategy of placing the nearshore-quality material at Fort Myers Beach (RSM 1) is the most economical placement option for the dredged material which also keeps the sediment in the active littoral system. The cost of placement on Fort Myers Beach was estimated at $10/CY (RSM 1) and placement at the Tampa ODMDS was conservatively estimated at $25/CY (NAV 1). The value of the RSM strategy relative to the ODMDS option is $1.0 million annually. Fort Myers Beach is a federal SPP and the estimated value of 169,000 CY of material placed within the depth of closure is $1.3 million based on the cost of material from an offshore borrow source.

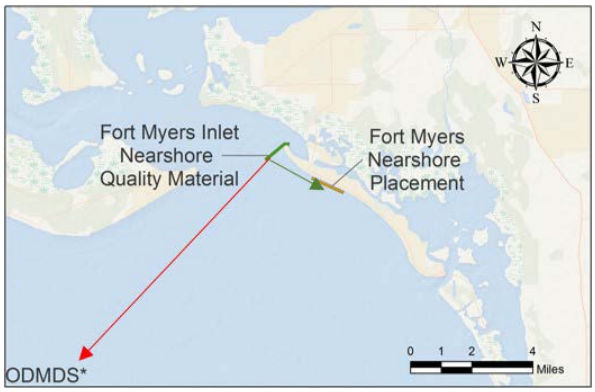


Figure 123. Map of Fort Myers RSM strategies. RSM strategies are indicated by green arrows correspond with highlighted strategies and value identified in Table 54.

**Note: ODMDS is not authorized for these projects so estimates are based on the Tampa ODMDS, the closest ODMDS option.*

Table 54. Summary of Costs and Value of Nearshore-quality Material for Projects at Fort Myers Inlet and Fort Myers Beach.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Fort Myers Inlet to Tampa ODMDS	3	$25	225,000	$0.5	$1.3	$7.4	$2.5
RSM 1	Fort Myers Inlet to Fort Myers Nearshore	3	$10	225,000	$0.5	$1.7	$4.5	$1.5
							RSM Value Strategy 1:	$1.0
	FRM Benefit A	3	$23	169,000			$ 3.9	$1.3
							TOTAL COMBINED RSM Value Strategy 1:	**$2.3**

RSM value for Strategy 1 was calculated by subtracting the cost of the NAV project from the RSM project and adding FRM Benefit A.
FRM Benefit A was estimated based on the volume of sand placed in the nearshore from RSM 1 times the cost per CY from an offshore borrow source.

Opportunities for Action

While material from Fort Myers Inlet is of nearshore-quality, other potential beneficial uses of dredge material in the project area could include TLP or island habitat creation in the estuarine environments adjacent to the shallow draft channels.

4.4.21 Channel from Naples to Big Marco Pass: 12-foot Channel Gordon Pass to Naples, FL

Summary

SAJ manages beach-quality dredged material from Gordon Pass (Collier County, FL) as part of the Naples to Gordon Pass Maintenance Dredging Project. Approximately 100,000 CY of beach-quality material is dredged from Gordon Pass every ten years, which is placed on the beach at Keewaydin Island at a value of $0.5 million annually to both the NAV program and the local beach at Keewaydin Island (Figure 124).

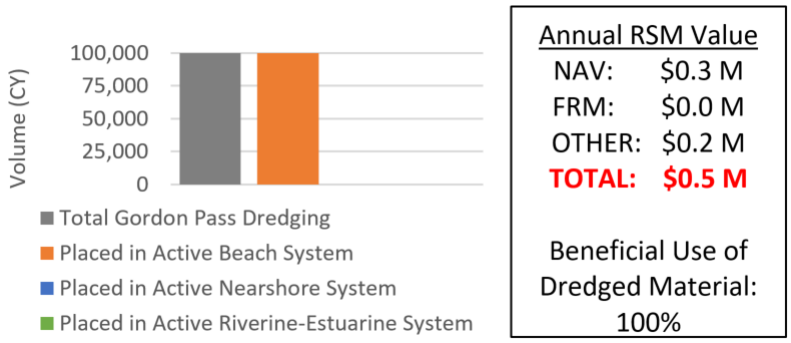


Figure 124. Total volume of sediment regularly dredged from Fort Myers Inlet (standard dredge cycle: 10 years). Total annual RSM value is $0.5 million.

**Beneficial use estimate only includes dredged material in the entrance channel.*

Introduction

Gordon Pass is shallow draft Navigation projects in Collier County (Figure 125). Project depth is 12 feet MLLW with a two-foot allowable overdepth for the channel entrance and 10-feet MLLW with a two-foot allowable overdepth for the remainder of the channel. Local offshore placement options for dredged materials have not been established and upland placement options are limited.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 125 and Table 55. Beach-quality material is dredged from Gordon Pass approximately every ten years. Due to the distance to the closest available ODMDS (Tampa) and expense of upland placement, the RSM strategy of placing the beach-quality material Keewaydin Island (RSM 1) is the most economical placement option for the dredged material which also keeps the sediment in the active littoral system. The cost of placement on Keewaydin Island was estimated at $12/CY (RSM 1) and upland placement, dewatering, and offloading was estimated at $38/CY (NAV 1). The value of the RSM strategy relative to the

Figure 125. Map of Gordon Pass RSM strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and Table 55. No ODMDS is available and upland dewatering / offloading is the primary non-RSM alternative.

ODMDS option is $0.3 million annually. While Keewaydin Island is not a federal SPP, the estimated value of placing sand on the beach at no additional cost to the Federal Government or local sponsor is $0.2 million annually (based on cost per CY of sand for Gasparilla Island beach nourishment from offshore source).

Table 55. Summary of Costs and Value of Beach-quality Material for Project at Gordon Pass.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Gordon Pass to upland dewatering	10	$38	100,000	$0.5	$0.7	$5.0	$0.5
RSM 1	Gordon Pass to Keewaydin Island beach	10	$12	100,000	$0.5	$0.5	$2.2	$0.2
							RSM Value Strategy 1:	$0.3
	OTHER Benefit A	10	$23	75,000			$ 1.7	$0.2
							TOTAL COMBINED RSM Value Strategy 1:	**$0.5**

RSM value for Strategy 1 was calculated by subtracting the cost of the NAV project from the RSM project and adding OTHER Benefit A. OTHER Benefit A was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

Opportunities for Action

All dredged material from Gordon Pass is beneficially placed.

4.4.22 San Juan Harbor Navigation Project

Summary

SAJ manages the San Juan Harbor NAV Project in Puerto Rico. Currently, approximately 200,000 CY of material is dredged from the project every five years and is placed offshore in an ODMDS (Figure 126). Some RSM opportunities have been identified but project costs and RSM value have not been estimated.

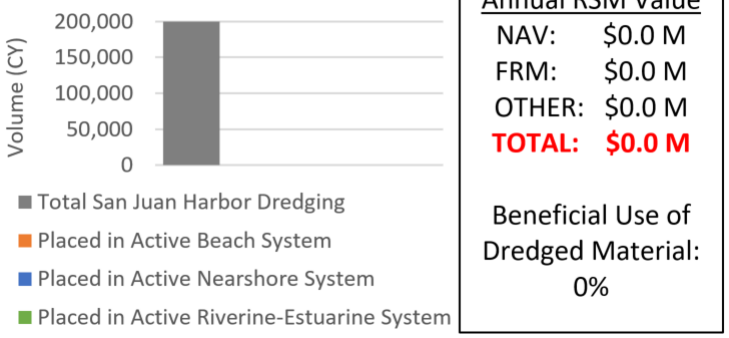


Figure 126. Total volume of sediment regularly dredged from San Juan Harbor (standard dredge cycle: 5 years). All material is currently placed in an ODMDS.

The majority of dredged material from San Juan Harbor is not suitable for beach placement and opportunities for beneficial use of dredged material could include filling of dredge holes or creating SAV habitat. As a result of coordination with project sponsors, agencies, and the Jacksonville District, Condado Lagoon was selected as one of ten beneficial use pilot projects under Section 1122 of the Water Resources Development Act (WRDA) of 2016. The pilot project will be executed in FY21 and will fill relict dredge holes and support development of environmental habitat. The limited beach-quality material could be used to address erosion and coastal storm damage at metropolitan beaches to the east and west of the harbor entrance.

Introduction

The San Juan Navigation Project is located on the northern coast of Puerto Rico along the Atlantic Ocean (Figure 127). Recent major deepening events include deepening and widening the Entrance Channel to 38 feet (1935), deepening the Army Terminal Channel, Puerto Nuevo Channel, and Graving Dock Channel (1999), and deepening the Entrance Channel to 49-56 feet (2001). San Juan Harbor is the principal port for the island and handles over 75% of the country's non-petroleum waterborne commerce. SAJ dredged approximately 600,000 CY from San Juan Harbor in 2012 and all of the material was placed in the ODMDS.

Figure 127. Map of San Juan Harbor, Puerto Rico indicating locations of interest.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 128 and Table 56. Traditionally, all dredged material is placed in the ODMDS at a cost of $9/CY and a total project cost of $5.8 million (NAV 1). A very limited volume of beach-quality material is dredged from San Juan Harbor every five years. While the volume is minor, Puerto Rico has many smaller pocket beaches that could utilize the beach-quality sand to mitigate erosion and provide shoreline protection. The current cost of placement on the beach is prohibitively expensive but value could be realized if coupled with a beach placement project or additional support from local sponsors.

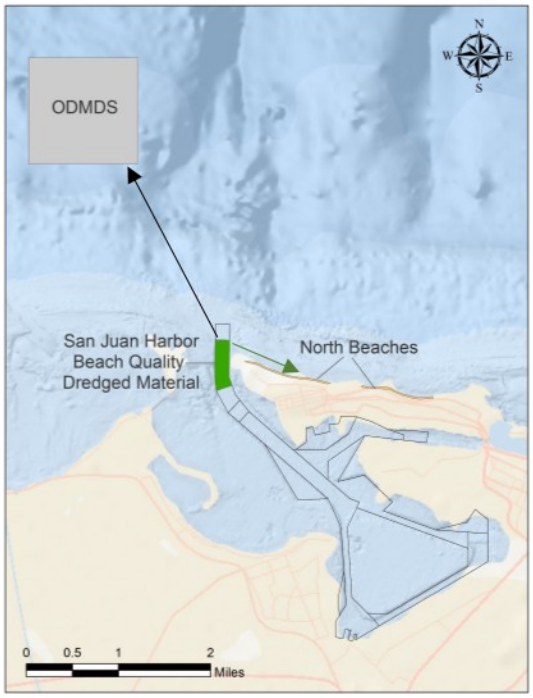


Figure 128. Map of San Juan Harbor and areas associated with the navigation project. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 56.

Opportunities for Action

The majority of dredged material from San Juan Harbor is not suitable for beach placement (Table 56). Opportunities for beneficial use of dredged material could include filling of dredge holes or creating SAV habitat. Dredge holes are located throughout the area and projects to fill dredge holes and develop SAV habitat have proven successful at improving water quality and wildlife habitat in other similar environments (Tampa Bay). One such area is within Condado Lagoon, where several dredge holes exist. The Condado Lagoon project was selected as one of ten projects nationally for WRDA 2016 1122, Beneficial Use of Dredged Material Pilot Program.

Beaches that could be nourished with sand from La Esperanza, or any other beach-quality sand dredged from the harbor, include metropolitan beaches to the east and west of the harbor entrance. Particularly to the east of the harbor, high value infrastructure along the beachfront is threatened by erosion and coastal storms. Beach nourishment using sand dredged from the harbor or La Esperanza could reduce storm damages. In order to address concern over impacts to nearshore environmental resources, a small demonstration project could be constructed and monitored to determine if beach nourishment is an effective and acceptable method of storm risk management. However, due to the adjacent rocky coastline providing significant habitat for hard bottom resources and coral reefs containing threatened species, only very minimal beach fill will likely be permittable.

Approximately eighteen miles to the east of the harbor entrance, the town of Loiza has two large excavated holes (averaging 2,200 feet x 400 feet) excavated within 400 feet of the shoreline. The holes have been a hazard to the local community, resulting in at least one drowning and providing habitat for

mosquito breeding. There is the potential for these holes to be filled with dredged material and converted to an environmental resource. This option would not be a least-cost alternative to the harbor for dredged material placement, but could be accomplished under the Continuing Authorities Program (CAP) Section 204 authority.

Dredged rock, gained from future potential deepening and widening could be used as construction material from revetments and/or breakwaters. The community of Cataño, located west of the Army Terminal Turning Basin, is a nearby area that could potentially benefit from erosion prevention measures constructed of rock.

There have also been discussions related to the beneficial use of dredged material to construct a submerged "bed" with a crest elevation of -3 to -6 feet in the middle of the inner-harbor (Puerto Nuevo Bay). Dredged rock could be used to contain the material. Existing submerged aquatic vegetation (SAV) adjacent Puerto Nuevo channel and army terminal turning basin occur at these depths, could be impacted by future potential harbor improvements (widening), and could provide the source for natural recruitment of red and green macro algae and sea grass onto the submerged bed. Once established, this area would provide significant ecological function (essential fish habitat and listed species forage resources). In addition, the SAV would trap sediment, which could improve water quality.

Table 56. Summary of Costs and Value of Beach-quality Material for Project at San Juan Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	San Juan Harbor to ODMDS	5	$9	200,000	$0.7	$3.3	$5.8	$1.2
RSM 1	San Juan Harbor to North Beaches	5	$23	200,000	$0.7	$5.0	$10.3	$2.1

Table 57. Summary of Costs and Value of Other Dredge Material for Project at San Juan Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	San Juan Harbor to Condado Lagoon	one time	$48	60,000	$0.7	$3.6	$7.2	$7.2

4.5 Mobile District (SAM)

The RSM Optimization Update analyzed 13 projects in the Mobile District including nine NAV projects and four FRM projects.

4.5.1 Summary of Navigation and Flood Risk Management Projects

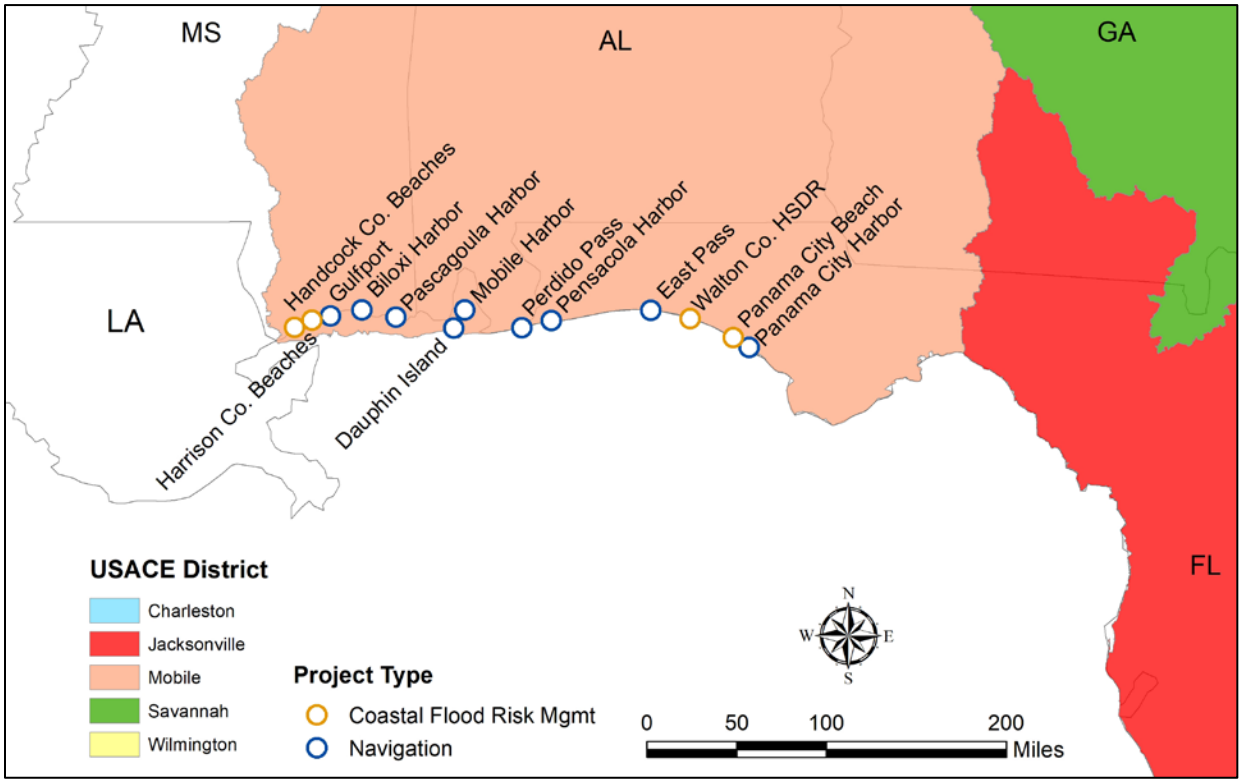
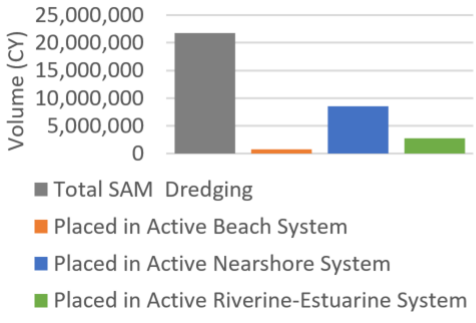


Figure 129. Map of Mobile District projects reviewed under the 2020 SAD RSM Optimization Update.

Overview

NAV and FRM projects managed by the Mobile District were analyzed for economic and environmental efficiencies relative to dredged material placement and beneficial use of dredged material. Implementation of RSM principles and strategies provides an estimated $17.3 million in annual value to the Mobile District (Figure 130). Based on data from nine NAV projects in the Mobile District, an estimated 22 million CY is dredged per dredge cycle and 56% of the material is managed by RSM principles.



Annual RSM Value	
NAV:	14.7 M
FRM:	$0.0 M
OTHER:	$2.6 M
TOTAL: $ 17.3 M	

Beneficial Use of Dredged Material: 56%

Figure 130. Average volume of sediment dredged from SAM NAV projects per standard project dredge cycles. Total annual RSM value is $17.3 million.

RSM Value and Sediment Placement

Of the nine Mobile District NAV projects analyzed, four projects (Panama City, East Pass, Perdido Pass, and Dauphin Island) beneficially place 100% of the projects' dredged material. Biloxi Harbor beneficially places 98% of the project's dredged material (Table 58). The highest dredged material volume comes from Mobile Harbor channels, approximately 35% of all SAM dredged material volume. Mobile Harbor channels also provide 76% of all Mobile District RSM value ($13.2 million). The two next-highest dredged material volume projects are Gulfport and Pascagoula Harbor, which remove 8.1 million CY and 3.6 million CY from project channels per dredge cycle, respectively, with a total combined annual RSM value of $1.5 million.

Of the 56% of material that is managed by RSM principles, 4% (800,000 CY) is placed on beaches, 39% (8.5 million CY) is placed in nearshore environments, and 15% (2.8 million CY) is placed in estuarine/riverine environments (Figure 131). Projects at Panama City, East Pass, Pensacola Harbor, and Perdido Pass have beach-quality sand that is beneficially placed on adjacent beaches for a total annual value of $2.4 million to St. Andrews State Park (Panama City), Okaloosa Island (East Pass), Perdido Key (Pensacola Harbor), and Orange Beach (Perdido Pass). Beach placement is the least-cost placement option for the projects, providing value to USACE and the NAV program, as well as shore protection and habitat benefits to adjacent property owners at no additional expense to the adjacent property owners.

Table 58: Total Dredge Volume and Value of RSM Implemented Mobile District NAV-FRM Projects.

Project	*Total Dredge Volume (CY)	% Managed by RSM Strategies	Annual RSM Value ($ M)
SAM Total	**21,745,000**	**56%**	**$17.3**
Panama City Harbor and CSDR	200,000	100%	$1.0
East Pass and Walton County CSDR	200,000	100%	$0.3
Pensacola Harbor	525,000	38%	$0.3
Perdido Pass	370,000	100%	$0.8
Mobile Harbor	7,190,000	42%	$13.2
Dauphin Island	215,000	100%	$0.2
Pascagoula Harbor and Beach CSDR	3,600,000	68%	$1.5
Biloxi Harbor	1,320,000	98%	$0.0
Gulfport and Harrison/Hancock CSDR	8,125,000	51%	$0.0

*Total dredge volume calculated as the sum of all material dredged from NAV projects per dredge cycle.

For Pensacola Harbor, beach-quality sand is placed in the littoral zone (approximately -2 to -12 feet MLLW) which minimizes equipment on the beach and potential impacts to shore birds and nesting sea turtles. This placement practice has been accepted by the National Park Service for several projects in SAM and could potentially be used as a model for beach placement in other districts. The Panama City Harbor, East Pass, Pensacola Harbor, Mobile Harbor, Dauphin Island, and Pascagoula Harbor projects contain cuts with beach-quality sand that is beneficially used by placement in nearshore feeder berms (Mobile, Pascagoula Harbors) or on the beach (Dauphin Island).

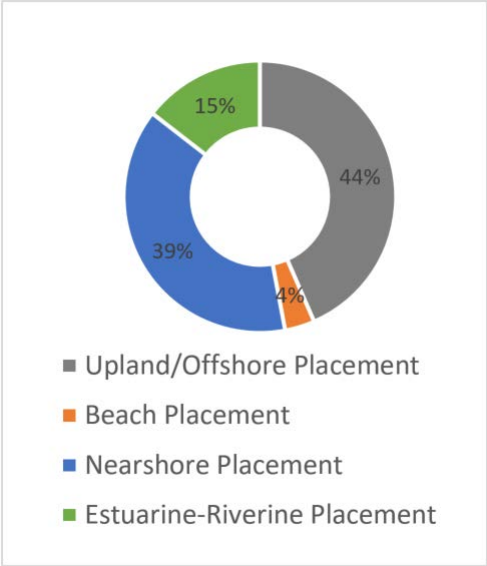


Figure 131. Distribution of placement by category for material dredged from SAM NAV projects.

The majority of dredged material in the Mobile District consists of a combination of sand, silt, mud and clay that is not suitable for beach placement. The Mobile District executes several RSM strategies for placing this material which includes: open water placement, TLP, and wetland creation. TLP strategies have been implemented in Escambia River, Mobile Harbor, Pascagoula Harbor, Biloxi Harbor, Gulfport, and the Gulf Intracoastal Waterway. The annual value for TLP in Mobile is estimated at $13.2 million. Value relative to traditional upland or offshore placement for both TLP and open water placement was limited, so values estimated in this report should be considered conservative. Wetland creation projects are providing significant placement capacity at Pascagoula Harbor (Singing River Island) and will provide capacity at Escambia River (Macky Island). Beneficial use of dredged material from Biloxi Harbor is used to restore wetland and coastal habitat at Deer Island. The Deer Island Restoration Project, a federally funded project in the Mississippi Coastal Improvements Program, was recently selected as one of ten beneficial use pilot projects under the WRDA 2016 Section 1122 Beneficial Use of Dredged Material. The pilot project was constructed in 2019 and was the first project in the 1122 program to be completed.

Over the last several years, TLP has become a beneficial use gaining interest within the coastal management community. Generally, removal of sediment from harbors has resulted in harbor deepening and bank erosion so keeping sediment in the harbors has become a priority. The O&M challenge is to maintain navigational depths while beneficially using dredged material in the bays and harbors. In Mobile, TLP occurs in waters deeper than four feet with the layer being approximately 6 inches to 1 foot thick. TLP is defined and implemented differently in different states and regions depending on geographic specific site conditions and regulatory requirements.

Opportunities for Action

The Mobile District beneficially places all beach-quality sand and is very efficient at utilizing open water and TLP opportunities. Developing additional RSM strategies is challenging considering the relatively low

cost of placement at upland and offshore placement sites. SAM has identified additional TLP opportunities in Mobile Harbor that could be implemented in future years. Other potential opportunities could include filling of relict shell mined areas and coastal and wetland habitat restoration and creation projects.

4.5.2 Panama City Harbor Navigation and Panama City Beach Hurricane Storm Damage Reduction Projects

Summary

SAM manages beach-quality dredged material from the Panama City Harbor NAV project in an environmentally and economically efficient manner. Approximately 200,000 CY of beach-quality material is dredged from Panama City Harbor every two years, which is placed on the beach east of the channel at St. Andrews State Park (Figure 132). Beach placement is the cheapest placement strategy; the value of the sand placed on the beach provides an estimated value of $1.0 million annually to the beach at St. Andrews State Park at no additional cost to the Federal Government. Strategic placement downdrift of the channel minimizes erosion and supports a sustainable beach for recreation and environmental habitat for sea turtles and nesting shore birds at St. Andrews State Park.

The Panama City Beach HSDR project utilized beach-quality sand from an offshore borrow area. While Panama City Harbor does do not contain enough beach-quality sand to support all shoreline storm damage reduction needs for the Panama City Beach HSDR, the sand does help reduce erosion at St. Andrews State Park.

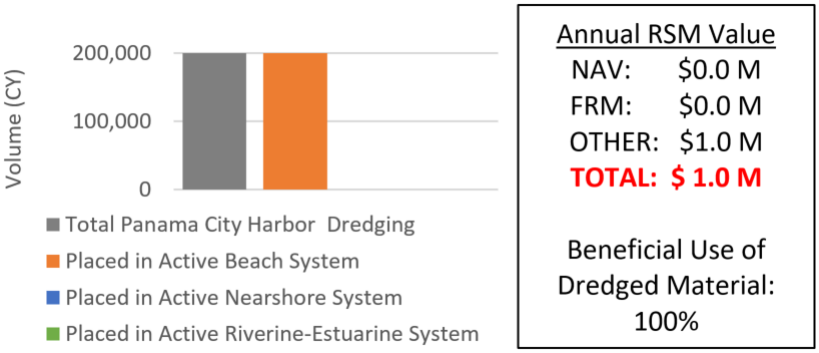


Figure 132. Average volume of sediment dredged from Panama City Harbor per dredge cycle (standard dredge cycle: 2 years). Total annual RSM value is $1 million. RSM strategies provide $0.7 million of annual value to the adjacent beaches at Panama City Harbor.

Value relative to offshore or upland placement was not calculated as comparative costs were not available. There is no upland or offshore placement option for Panama City Harbor.

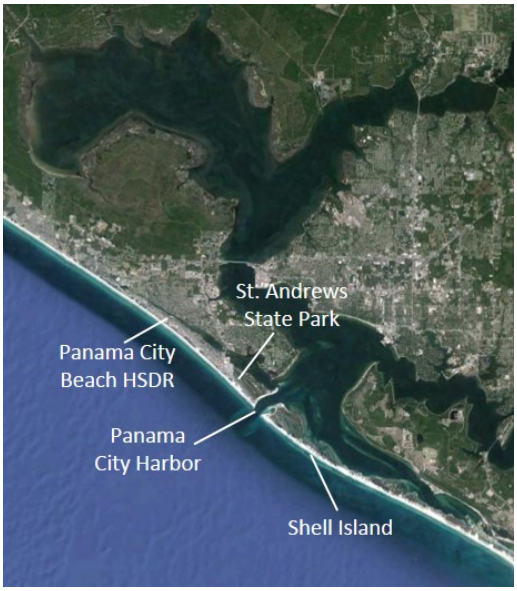


Figure 133. Map illustrating locations of interest near the Panama City Harbor Navigation and Panama City Beach HSDR projects.

Introduction

The Panama City Harbor NAV and Panama City Beach HSDR projects are located in Bay County, FL (Figure 133). Port Panama City is located on the Gulf Intracoastal Waterway in St. Andrews Bay. The Gulf Approach Channel and channel across Lands End and in the bay is

approximately 3.7 miles in length and is maintained at 34 and 32 feet, respectively. The Port anticipates increasing tonnage to approximately 2.1 to 2.4 million tons over the next several years which would be evenly split between general cargo and bulk commodities (Panama City Port Authority, 2016). The Panama City HSDR spans approximately 18 miles from Philips Inlet eastward to Panama City Harbor.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 134 and Table 59. All beach-quality material dredged from the Panama City Harbor Gulf Approach Channel and across Lands End and in the bay is placed on the beach at St. Andrews State Park at an estimated cost of $13/CY (RSM 1). Total annual cost for dredging the Panama City Harbor Entrance Channel is estimated at $1.4 million. Comparative costs relative to upland placement or ODMDSs were not calculated as they are not permitted and would be economically impractical. The implemented RSM strategy is the cheapest placement option for the dredged material.

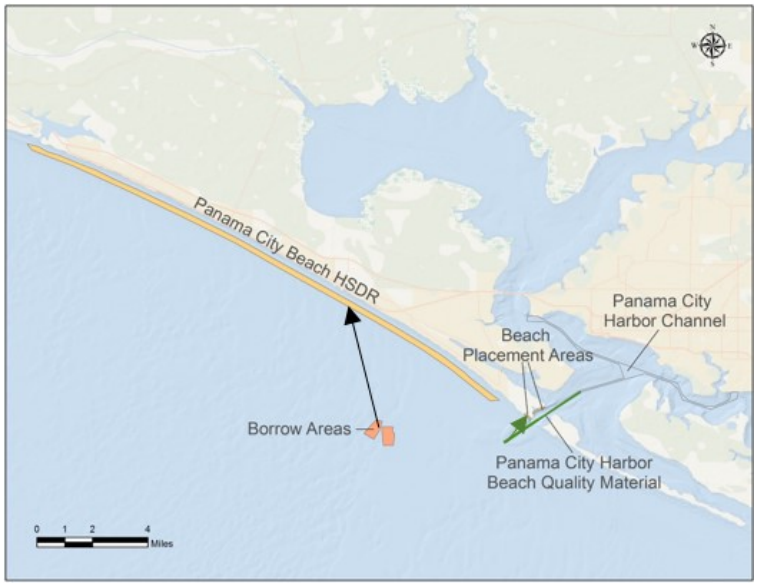


Figure 134. Map of Panama City Harbor and Panama City Beach HSDR placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and values identified in Table 59.

The value of the RSM strategy is $1.0 million annually assuming a value of $13/CY for sand placed on the beach at St. Andrews State Park at no cost to the federal or state governments. Beach placement minimizes downdrift impacts and is the environmentally responsible placement option as it is consistent with natural coastal processes at the inlet and supports habitat for nesting sea turtles and shore birds.

The Panama City Beach HSDR utilizes sand from an offshore borrow source to maintain adequate shore protection. The project is nourished every ten years for a total project cost of $14.3 million or $1.4 million annually (HSDR 1). The offshore sand source is the cheapest source of beach-quality material for the project.

Table 59. Summary of Costs and Value of Beach-quality Material for Projects at Panama City Harbor and Panama City Beach.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Panama City Harbor Entrance Channel to Beach	2	$13	200,000	$0.1	$0.2	$2.8	$1.4
	RSM 1 OTHER Benefit	2	$13	150,000			$2.0	$1.0
						Total RSM Strategy 1 Value:		$1.0
HSDR 1	Offshore Borrow to Panama City Beach	10	$13	1,100,000	$1.0	$2.0	$14.3	$1.4

RSM 1 OTHER Benefit was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

4.5.3 East Pass Navigation and Walton County Hurricane Storm Damage Reduction Projects

Summary

SAM manages dredged material from the East Pass NAV project in an environmentally and economically efficient manner. Approximately 200,000 CY of beach-quality material is dredged from East Pass every five years that is placed in the littoral zone at Okaloosa Island, east of the Pass (Figure 135). Littoral zone placement is the cheapest placement option. This placement strategy keeps sand in the active system, minimizes downdrift impacts, and is a less disruptive placement strategy relative to beach placement for nesting sea turtles. The value of the sand placed on Okaloosa Island provides a value of $0.4 million annually at no cost to the Federal Government.

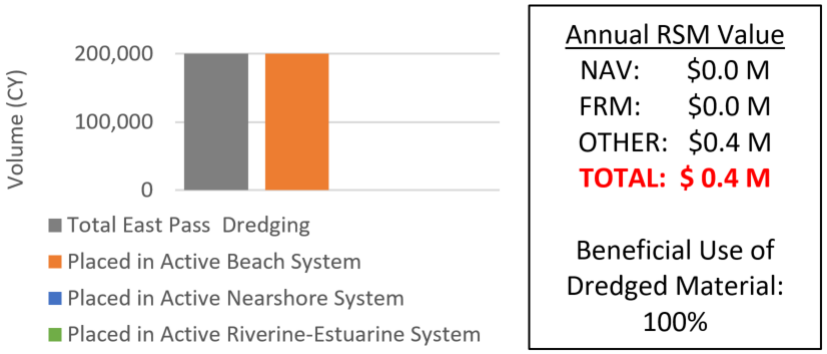


Figure 135. Average volume of sediment dredged from East Pass per dredge cycle (standard dredge cycle: 5 years). RSM strategies provide $0.4 million of annual value to the adjacent beach at Okaloosa Island.

Value relative to offshore or upland placement was not calculated as comparative costs were not available.

The City of Destin has a permit to use material from East Pass and the revised inlet management plan documents reversals in sediment transport that include both east and west transport components. Future dredging may include beach and littoral zone placement at Destin. Placement east of the pass may be done by USACE, provided that any additional cost is borne by the State of Florida.

The Walton County HSDR project has not been constructed but plans to place approximately 4.3 million CY of beach-quality material from an offshore borrow source along five segments of county beaches every ten years. There is not sufficient beach-quality material from other potential beneficial use sources to support the HSDR project.

Figure 136. Map illustrating locations of interest near the East Pass Navigation and Walton County HSDR projects.

Introduction

The East Pass NAV project is located in Okaloosa County, FL (Figure 136). East Pass is bounded on the east by the City of Destin and on the west by Okaloosa Island. Placement options for East Pass include upland and littoral zone placement although upland placement is not currently utilized. SAM places

beach-quality material on the downdrift beach on Okaloosa Island west of the Pass from +3 feet to -12 feet elevation MLLW. Future dredging may include placement of material on the beach at Destin.

The Walton County HSDR provides shore protection over approximately 19 miles of shoreline and includes dune enhancement in addition to traditional beachfill. The project consists of five reaches: (1) Miramar Beach, Sandestin, and Four Mile Village, (2) Topsail Hill State Preserve, (3) Beach Highlands, Dune Allen, Santa Rosa Beach, Blue Mountain, and Gulf Trace, (4) Grayton Beach State Park East, Grayton Beach, Grayton Beach State Park West, and (5) Watercolor, Seaside, Seagrove, Watersound Seacrest Rosemary, and Inlet Beach. Walton County's shoreline is receding with protective dunes and high bluffs being destroyed by hurricanes and storms. Hurricanes in 2004 and 2005 (Ivan, Dennis, Katrina) caused significant damage to property and infrastructure along the shoreline.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 137 and Table 60. Beach-quality material is dredged from East Pass approximately every five years. All dredged material is currently placed on the beach at Okaloosa Island at an estimated cost of $10/CY (RSM 1). Total annual cost for dredging the East Pass Entrance Channel is estimated at $0.5 million. Comparative costs relative to upland placement or ODMDSs were not calculated as they are economically impractical and there is no permitted ODMDS. The implemented RSM strategy is the cheapest placement option for the dredged material.

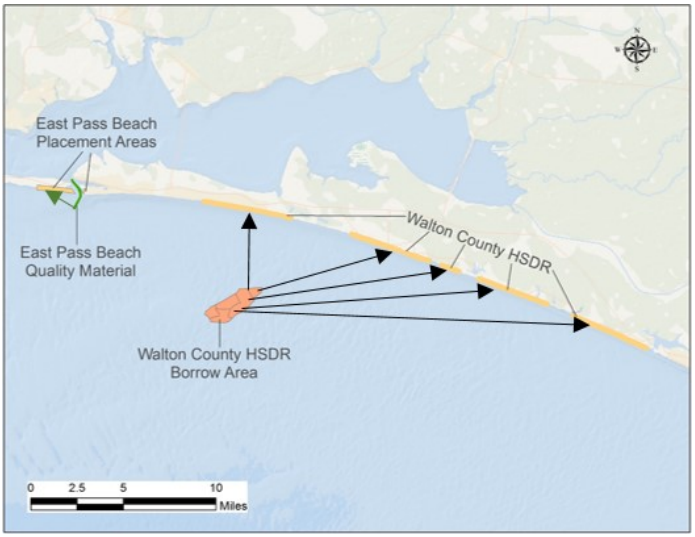


Figure 137. Map of East Pass NAV and Walton County HSDR placement strategies. RSM strategies are indicated by green arrows correspond with highlighted strategies and value identified in Table 60.

The value of the RSM strategy is $0.4 million annually assuming a value of $13/CY for sand placed on the beach at Okaloosa Island at no cost to the Federal Government. Littoral zone placement minimizes downdrift impacts and is the environmentally responsible placement option as it is consistent with natural coastal processes at the passes and supports habitat for nesting sea turtles and shore birds.

The Walton County HSDR (currently unconstructed) utilizes sand from an offshore borrow source to maintain adequate shore protection. The project is planned to be nourished every ten years for a total project cost of $54 million or $5.4 million annually (HSDR 1). The offshore sand source is the cheapest source of beach-quality material for the project and closest source with sufficient material to support the required project volumes.

Table 60. Summary of Costs and Value of Beach-quality Material for Projects at East Pass and Walton County.

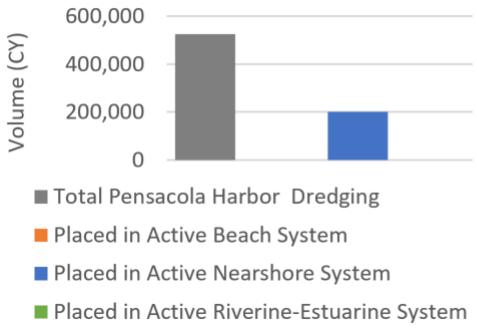
Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	East Pass Entrance Channel to Beach	5	$10	200,000	$0.1	$0.2	$2.3	$0.5
	RSM 1 OTHER Benefit	5	$13	150,000			$2.0	$0.4
						Total RSM Strategy 1 Value:		**$0.4**
HSDR 1	Offshore Borrow to Walton County HSDR	10	$13	4,300,000	$0.1	$2.0	$53.8	$5.4

RSM 1 OTHER Benefit was estimated based on the volume of sand placed on the beach from RSM 1 (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

4.5.4 Pensacola Harbor Navigation Project

Summary

SAM manages beach-quality dredged material from the Pensacola NAV projects in an environmentally and economically efficient manner. Approximately 200,000 CY of beach-quality material is dredged from Pensacola Harbor every four years. It is placed in the channel to support dispersal to the adjacent flood shoals and nearshore environments.



Annual RSM Value
NAV: $0.0 M
FRM: $0.0 M
OTHER: $0.3 M
TOTAL: $ 0.3 M

Beneficial Use of Dredged Material: 38%

Figure 138. Average volume of sediment dredged from Pensacola Harbor per dredge cycle (standard dredge cycle: 2 years [Approach Channel, Inner Harbor Channel to 4 years [Entrance Channel]). Total annual RSM value is $0.3 million.

In-channel placement and nearshore dispersal provide an estimated value of $0.3 million annually to the National Park Service at Perdido Key in the form of shore protection at no additional cost to the Federal Government (Figure 138). Strategic placement supports a healthy flood shoal complex and sustainable beach for recreation and environmental habitat for sea turtles and nesting shore birds. In addition, in channel placement reduces the volume of material placed at the ODMDS which has limited capacity. Identifying and permitting ODMDS sites is both expensive and labor intensive and all opportunities to preserve capacity of currently permitted disposal options should be encouraged.

An additional 325,000 CY of silt and mud is dredged from Pensacola Harbor every two years that is placed in the ODMDS. No beneficial use options were identified for this material.

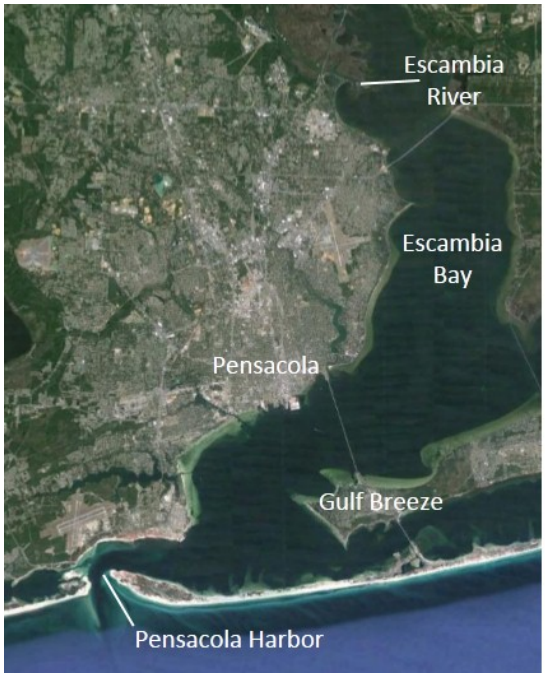


Figure 139. Map illustrating areas adjacent to navigation projects at Pensacola Harbor and Escambia River.

Introduction

The Pensacola Harbor NAV Project is located between Pensacola Beach, FL and Perdido Key (Figure 139). Pensacola is a popular tourist destination for beachgoers and Perdido Key is part of the Gulf Islands National Seashore managed by the National Park Service. The spit located between Pensacola Beach and Pensacola Harbor is also managed by the National Park Service. Placement options for dredge material include standard DMMA and ODMDS options as well as authorized littoral zone placement areas.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 140 and Table 61. Beach-quality material is dredged from Pensacola Harbor every four years. All dredged material is currently placed on in in channel at an estimated cost of $3/CY (RSM 1). Total annual cost for dredging the Pensacola Harbor Entrance Channel is estimated at $0.2 million. Comparative costs relative to upland placement or ODMDSs were not calculated as estimated costs were not available.

The value of the RSM strategy is $0.8 million annually assuming a value of $10/CY for sand placed within the depth of closure providing shore protection benefits on the beach at Perdido Key. In channel placement minimizes downdrift impacts and is the environmentally responsible placement option as it is consistent with natural coastal processes at the inlet and supports habitat for nesting sea turtles and shore birds.

Figure 140. Map of Pensacola Harbor dredged material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 61.

Table 61. Summary of Costs and Value of Beach-quality Dredged Material for Project at Pensacola Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Pensacola Harbor Entrance Channel to in channel placement	4	$3	200,000	$0.1	$0.1	$0.8	$0.2
	RSM 1 OTHER Benefit	4	$10	100,000			$1.0	$0.3
						Total RSM Strategy 1 Value:		**$0.3**

RSM 1 OTHER Benefit was estimated based on the volume of sand placed on the beach from RSM 1 (assuming **50% loss** during placement) times the cost per CY from an offshore borrow source.

Silt/Mud Material Placement Strategies

Currently, all material dredged from the Pensacola East Approach Channel and Pensacola Inner Harbor Channel is placed in the ODMDS (see Figure 140) at an estimated cost of $4/CY (Table 62). Total annual cost for dredging the Pensacola East Approach and Inner Harbor Channels is $0.9 million annually. Capacity at the ODMDS is limited and opportunities for beneficial use of dredge material should be explored to prolong the life of the ODMDS. Placement strategies could include TLP or wetland creation within Pensacola Harbor. Both placement strategies have proven effective at other navigation projects throughout SAM.

Table 62. Summary of Costs and Value of Silt/Mud Dredged Material for Project at Pensacola Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Pensacola East Approach Channel to ODMDS	2	$4	250,000	$0.1	$0.1	$1.2	$0.6
NAV 2	Pensacola Inner Harbor Channel to ODMDS	2	$4	75,000	$0.1	$0.1	$0.5	$0.3

4.5.6 Perdido Pass Navigation Project

Summary

SAM manages beach-quality dredged material from the Perdido Pass NAV project in an environmentally and economically efficient manner. Approximately 370,000 CY of beach-quality material is dredged from Perdido Pass every three years which is placed in open water and on the beach adjacent to the project channel for an estimated value of $0.8 million annually (Figure 141).

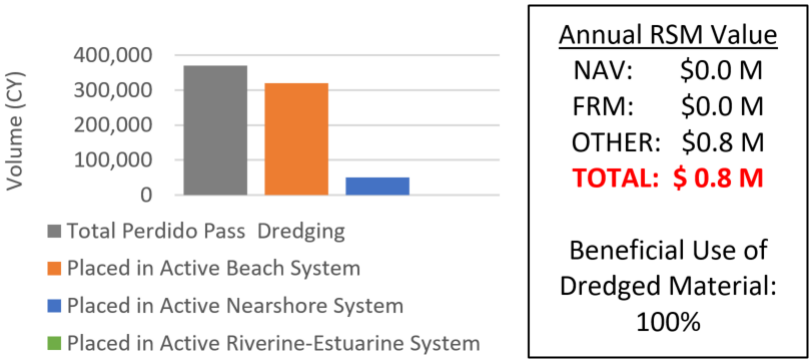


Figure 141. Average volume of sediment dredged from Perdido Pass per dredge cycle (standard dredge cycle: 3 years). Total annual RSM value is $0.8 million

Value was calculated based on value of sand placed on non-federal beaches. Value relative to offshore was not calculated as comparative costs were not available.

Beach placement is the primary and cheapest placement option. Offshore placement areas are not permitted for the project and RSM placement strategies are the only feasible options to execute the NAV project.

Introduction

The Perdido Pass Navigation Project is located along the Florida-Alabama border between Perdido Key, FL and Orange Beach, AL (Figure 142). The shallow draft project was completed in 1969 to stabilize the inlet. Beach-quality material is dredged from Perdido Pass and is placed on Orange Beach and Perdido Key, in the littoral zone at Orange Beach, and in open water sites (Figure 143). Sand is placed on the beach at sites adjacent to the Pass and along the west jetty to prevent undermining as needed. An ODMDS is not permitted for the project and RSM placement strategies are the only feasible options to execute the NAV project.

Figure 142. Map illustrating areas adjacent to Perdido Pass navigation project.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 143 and Table 63. Beach-quality material is dredged from

Perdido Pass every three years. All dredged material is currently placed on adjacent beaches or in open water for a per cubic yard placement cost of $3 and $6, respectively. Historically, material has been placed in the littoral zone placement areas and the areas remain a permitted placement strategy. Approximately 350,000 CY is dredged from the entrance channel for a cost of $0.8 million annually, 10,000 CY is dredged from the East Channel for an annual cost of $40,000, and 10,000 CY is dredged from West Channel for an annual cost of $40,000.

The value of the combined RSM strategies is $0.8 million annually assuming a value of $10/CY for sand placed on the beach. A combination of beach placement and open water placement inside the west jetty minimizes downdrift impacts to Orange Beach and undermining of the west jetty.

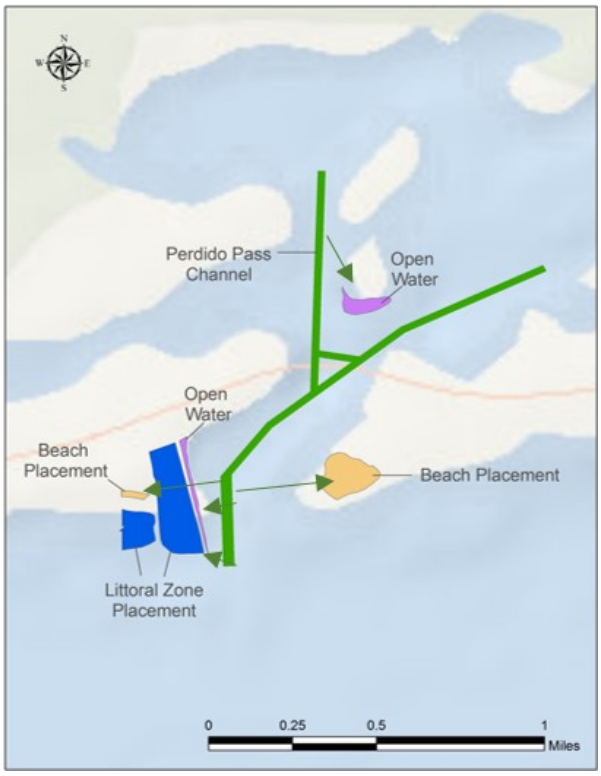


Figure 143. Map of Perdido Pass dredged material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 63. Material has been placed in the littoral zone placement areas in recent years and remains a permitted placement strategy.

Table 63. Summary of Costs and Value of Beach-quality Dredged Material for Project at Perdido Pass.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Entrance Channel and Impoundment Basin to Open Water-Littoral Zone	3	$3	50,000	$0.1	0.1	$0.3	$0.1
RSM 2	Entrance Channel and Impoundment Basin to Beach	3	$6	300,000	$0.1	0.1	$2.0	$0.7
	RSM 2 OTHER Benefit	6	$10	225,000			$2.3	$0.8
							Total RSM Strategy 2 Value:	**$0.8**
RSM 3	East Channel to Beach	3	$6	10,000	$0.1	$0.01	$0.1	$0.04
	RSM 3 OTHER Benefit	3	$10	7,500			$0.1	$0.03
							Total RSM Strategy 3 Value:	**$0.03**
RSM 4	West Channel (Terry Cove) to Beach	3	$6	10,000	$0.04	$0.03	$0.1	$0.04
	RSM 4 OTHER Benefit	3	$10	7,500			$0.1	$0.03
							Total RSM Strategy 4 Value:	**$0.03**
							TOTAL COMBINED RSM 1-4 Value:	**$0.8**

RSM 2, 3, 4 OTHER Benefit was estimated based on the volume of sand placed on the beach (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

4.5.7 Mobile Harbor Navigation Project

Summary

The Mobile District is currently managing dredged material from the Mobile Harbor Maintenance Dredging Project in an environmentally beneficial and economically efficient manner. SAM beneficially uses beach-quality material from Mobile Bar by placing dredged material at the Sand Island Beneficial Use Area (SIBUA) which feeds the active littoral system and downdrift islands. SAM bene-ficially uses silt and mud in Mobile Bay by placing material in designated TLP zones located adjacent to the project channel along the length of Mobile Bay to keep material in the system and help prevent shoreline erosion.

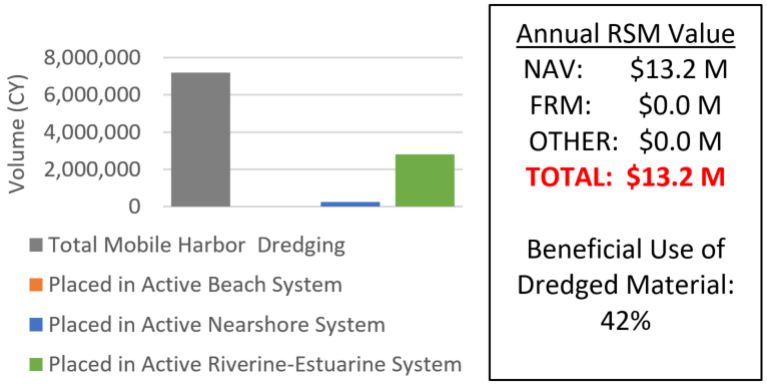


Figure 144. Average volume of sediment dredged from Mobile Harbor per dredge cycle (standard dredge cycle: 1–2 years). Total annual RSM value is $13.2 million.

Approximately 40% (3 million CY) of all dredged material is beneficially used and the value of implemented sediment management strategies is approximately $13.2 million to the NAV project with additional unquantified value to downdrift islands (Sand, Pelican, Dauphin Island) (Figure 144). Calculated value associated with placement of silt/mud is primarily a function of the shorter distance to the TLP zones relative to the ODMDS. The cost associated with placement of beach-quality material is equal for SIBUA and ODMDS options; however, placement at SIBUA allows for positive downdrift impacts at Sand, Pelican, and Dauphin Islands. SAM is currently exploring additional beneficial use opportunities for dredged material in the Mobile Bay and River.

Figure 145. Aerial map of Mobile Bay and adjacent areas.

Introduction

The Mobile Harbor project is located in southwestern Alabama adjacent to the Alabama-Mississippi border (Figure 145). The Alabama State Port Authority, located on the Mobile River, is one of the largest ports in the United States with over 60 million tons of commerce annually. Approximately 700,000 CY of beach-quality material and 6.2 million CY of silt/mud is dredged annually from the 40-mile-long project. All beach-quality material is located in Mobile Bar and silt/mud

is located in Mobile Bay, Mobile River, and Theodore Ship Channel (Figure 146). Placement options for dredge material include standard DMMA and ODMDS options as well as authorized SIBUA and TLP zones. New beneficial and economically feasible placement options are continuously being developed.

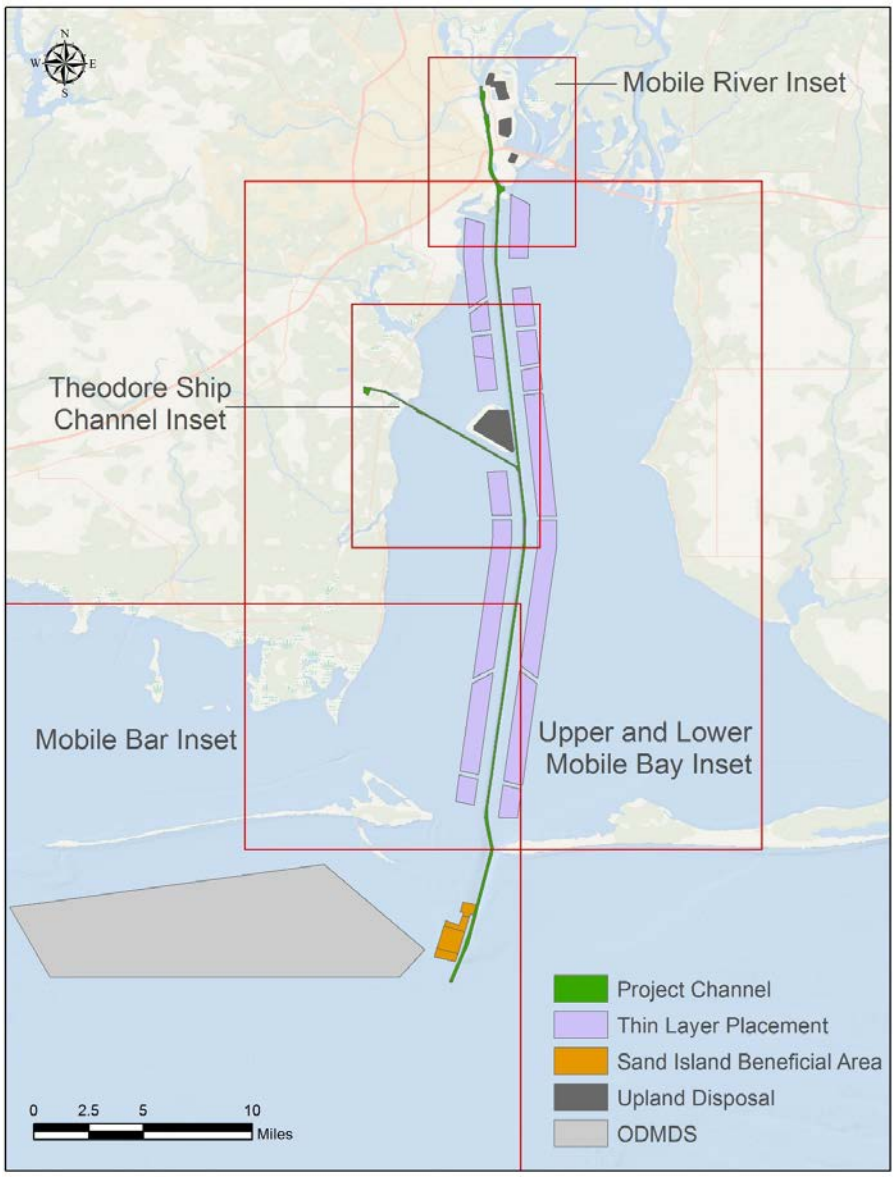


Figure 146. Map of Mobile Harbor indicating locations of project channels and placement locations. Inset maps are provide in Figure 147.

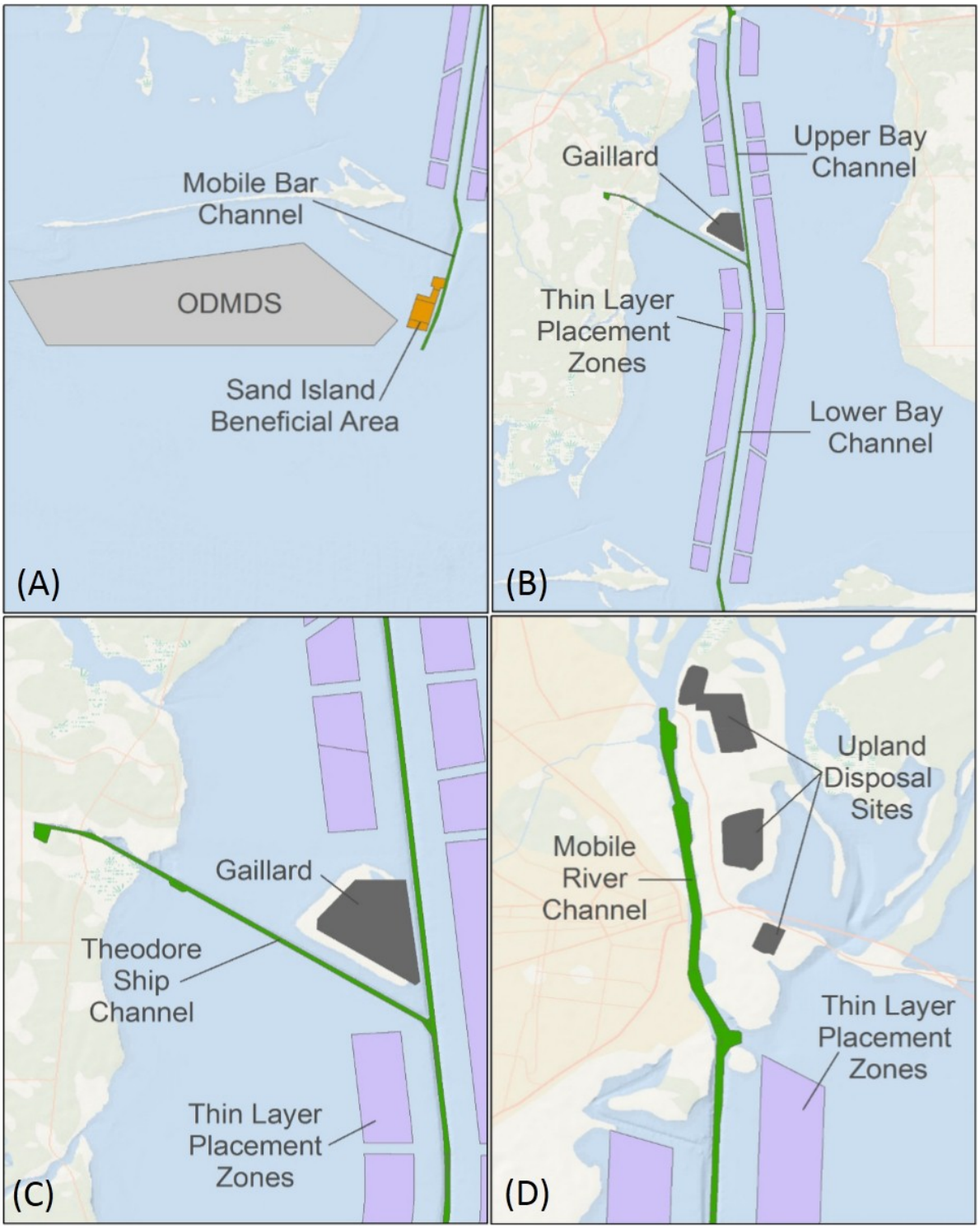


Figure 147. Maps of four Mobile Harbor project areas illustrating channel locations and dredge placement options. Four project areas are: (A) Mobile Bar, (B) Mobile Bay, (C) Theodore Ship Channel, and (D) Mobile River. Locations within Mobile Harbor referenced in Figure 146.

Beach-quality Material Placement Strategies

Beach-quality material is only located in Mobile Bar and placement options include the ODMDS and SIBUA (Figure 147A). A summary of beach-quality material placement strategies, total project costs, and value provided by RSM strategies is provided in Table 64. The cost per CY is equal for placement at the ODMDS and SIBUA; however, placement at SIBUA provides multiple environmental and economic benefits. Environmentally, sand placed at SIBUA keeps beach-quality sand in the active littoral system which helps feed Sand, Pelican, and Dauphin Islands, highly erosional barrier islands downdrift of Mobile Harbor. Placement at SIBUA allows SAM to conserve capacity of the ODMDS and expand the ODMDS's lifecycle. Identifying and permitting ODMDS sites is both expensive and labor intensive and all opportunities to preserve capacity of currently permitted placement options should be encouraged.

Table 64. Summary of Costs and Value of Beach-quality Material for Traditional and RSM Projects at Mobile Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Mobile Bar to Sand Island Beneficial Area	2	$3	250,000	$0.3	$0.2	$1.2	$0.6

Silt/Mud Material Placement Strategies

Silt/Mud is located throughout Mobile Bay, Mobile River, and the Theodore Ship Channel (Figure 146) and placement options include the ODMDS, TLP zones, and upland placement (Figure 147B, C, D). A summary of mud/silt material placement strategies, total project costs and value is provided in Table 65. Strategies for placement of material from Mobile Bay include placement in the ODMDS at a cost of $7/CY and in the TLP zones at a cost of $2/CY. SAM has executed the RSM strategy for silt/mud in Mobile Bay for the past several years at a savings of approximately $13.2 million annually relative to the ODMDS option. All quantified value is derived from savings associated with the cost of placement which is primarily a function of the shorter distance to the placement site. In addition, placement within Mobile Bay helps to maintain sediment in the active sediment system which provides environmental benefits.

RSM opportunities to place silt/mud from Mobile River to the TLP zones adjacent to the Mobile Bay Channel were identified but are currently not available for use unless under emergency circumstances (RSM 2). While the TLP zones are an option, they have limited capacity. It is economically more efficient to place material from Mobile Bay into the TLP zones relative to dredged material from Mobile River ($2/CY for Mobile Bay dredged material placement vs. $3/CY for Mobile River dredged material placement). TLP is also an option for placement of dredged material from Theodore Ship Channel (RSM 3), but limited capacity of the TLP zones and economic efficiency is also an issue which minimizes potential use as the cost to place at the Gaillard DMMA is comparable to the cost of placement at TLP zones.

Opportunities for Action

A significant amount of material, primarily silt and mud, is dredged from Mobile Bay, Mobile River, and Theodore Ship Channel that is currently being placed in DMMAs and the ODMDS. SAM is currently exploring RSM opportunities in Mobile River, but considering the volume of material dredged annually in these areas (7 million CY) to maintain required project depths, much of this material must be removed from Mobile Bay. Other potential beneficial uses of dredge material in the project area include filling of relict shell mined areas in the bay and island habitat creation.

Table 65. Summary of Costs and Value of Silt/Mud for Project at Mobile Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
Mobile Bay								
NAV 1	Mobile Bay to ODMDS	1	$7	4,000,000	$1.5	$0.2	$30.0	$29.7
RSM 1a	Mobile Bay to TLP Areas	1	$2	2,800,000	$1.5	$1.0	$8.1	$8.1
RSM 1	Mobile Bay to ODMDS	1	$7	1,200,000			$8.4	$8.4
						Combined Project RSM 1 Total Cost:		$16.5
						Total RSM Strategy 1 Value:		**$13.2**
Mobile River								
NAV 2	Mobile River to Blakely, Pinto, Mud Lakes (DMMA)	1	$3	1,700,000	$0.5	$0.3	$5.9	$5.9
NAV 3	Mobile River to ODMDS	1	$10	240,000			$2.4	$2.4
						Combined Project Non-RSM NAV 2 Total:		$8.3
Theodore Ship Channel								
NAV 4	Theodore Ship Channel to Gaillard (DMMA)	2	$2	1,000,000	$0.3	$0.5	$2.8	$1.4
RSM 2	Theodore Ship Channel to TLP Areas	2	$2	1,000,000	$0.3	$0.5	$2.8	$1.4
						POTENTIAL RSM Strategy 3 VALUE:		**$ 0.0**
						Total RSM Strategy VALUE:		**$13.2**

4.5.8 Dauphin Island Navigation Project

Summary

SAM manages beach-quality dredged material from the Dauphin Island NAV projects in an environmentally and economically efficient manner. Approximately 65,000 CY of beach-quality material is dredged from Fort Gaines and Pass Drury every three years which is placed on the beach and 150,000 CY of silty sand is dredged from Village Channel every five years and is placed in open water sites for an estimated value of $0.2 million annually (Figure 148).

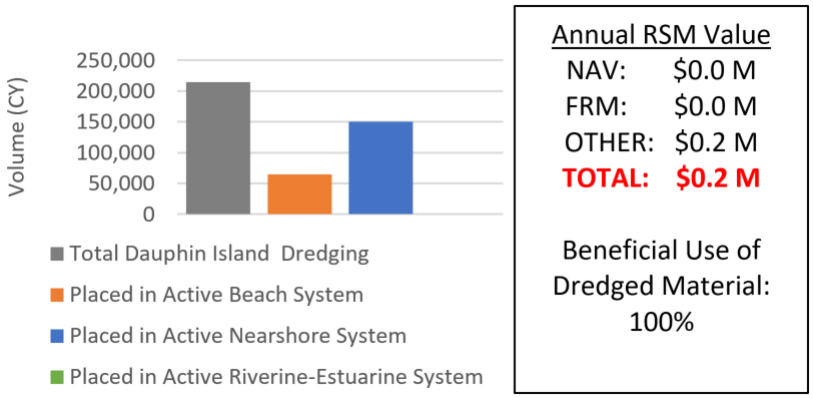


Figure 148. Average volume of sediment dredged from Dauphin Island per dredge cycle (standard dredge cycle: Fort Gaines, Pass Drury - 3 years; Village Channel – 5 years). Total annual RSM value is $0.2 million.

Value relative to offshore or upland placement was not calculated as comparative costs were not available.

Open water and beach placement are the cheapest placement options and implemented RSM placement strategies help to keep sediment in the active system to minimize potential erosion and downdrift impacts.

Introduction

The Dauphin Island NAV projects (Fort Gaines, Pass Drury, and Village Channel) are located adjacent to Dauphin and Little Dauphin Island along the western edge of the mouth of Mobile Bay (Figure 149). Fort Gaines and Pass Drury Channels are located between Dauphin Island and Little Dauphin Island along the eastern edge of the islands and Village Channel connects Dauphin Island with the Gulf Intracoastal Waterway (Figure 150). Dauphin Island is 14 miles in length and nearly two miles wide at its widest point. The Island is host to historic Fort Gaines, an Audubon Bird Sanctuary, and the Dauphin Island Sea Lab.

Figure 149. Map illustrating areas adjacent to Dauphin Island navigation project.

Beach-quality Material Placement Strategies

A summary of beach-quality material placement strategies and total project costs is provided in Figure 150 and Table 66. Beach-quality material is dredged from Fort Gaines and Pass Drury every three years and placed at the Little Dauphin Island beach at an estimated cost of $4/CY. Approximately 35,000 CY is dredged from Fort Gaines and 30,000 CY is dredged from Pass Drury for an annual cost of $0.1 million each.

The value of the RSM strategies is $0.2 million annually assuming a value of $10/CY for sand placed on beaches every three years. Value relative to offshore or upland placement was not calculated as comparative costs were not available and state law prohibits offshore or upland placement.

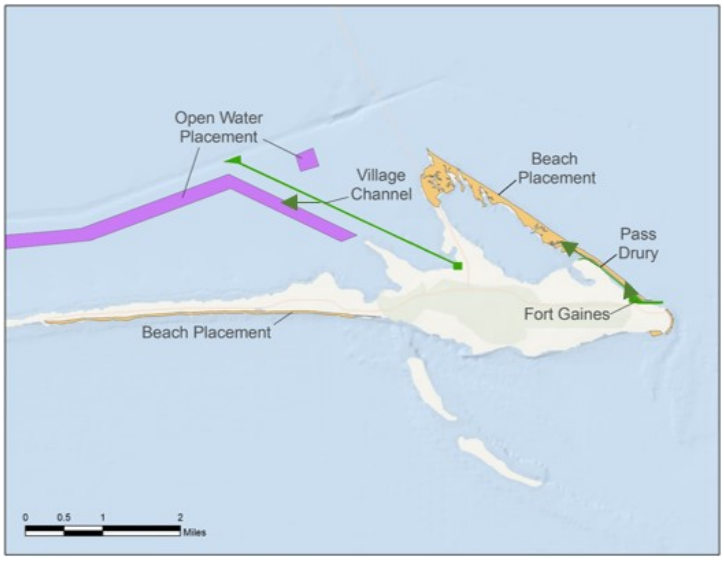


Figure 150. Map of Dauphin Island dredged material placement strategies. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 66.

Table 66. Summary of Costs and Value of Beach-quality Dredged Material for Projects at Dauphin Island.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Fort Gaines to Little Dauphin Island Beach	3	$4	35,000	$0.05	$0.2	$0.4	$0.1
	RSM 1 OTHER Benefit	3	$10	26,000			$0.3	$0.1
							Total RSM Strategy 1 Value:	**$0.1**
RSM 2	Pass Drury to Little Dauphin Island Beach	3	$4	30,000	$0.05	$0.2	$0.4	$0.1
	RSM 2 OTHER Benefit	3	$10	23,000			$0.2	$0.1
							Total RSM Strategy 2 Value:	**$0.1**
							Total RSM Strategies 1-2 Value	**$0.2**

RSM 1, 2 OTHER Benefit was estimated based on the volume of sand placed on the beach (assuming 25% loss during placement) times the cost per CY from an offshore borrow source.

Silt/Mud Material Placement Strategies

Silt and mud material is dredged from Village Channel every five years and placed in open water sites adjacent to the channel at an estimated cost of $4/CY (Table 67). Approximately 150,000 CY is dredged from Village Channel for an annual cost of $0.1 million. The RSM strategy of placing material in open water sites is the cheapest placement option. Value relative to offshore or upland placement was not calculated as comparative costs were not available and state law prohibits offshore or upland placement.

Table 67. Summary of Costs and Value of Silt/Mud Dredged Material for Project at Dauphin Island.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	Village Channel to Open Water	5	$4	150,000	$0.05	$0	$0.6	$0.1

4.5.9 Pascagoula Harbor Navigation Project and Pascagoula Beach Hurricane Storm Damage Reduction Projects

Summary

SAM manages dredged material from the Pascagoula Harbor NAV project in an environmentally and economically efficient manner. Approximately 2.5 million CY of material is dredged from Pascagoula Harbor that is placed in the littoral zone for an overall value of $1.5 million to the NAV program (Figure 151). This total does not include value associated with utilizing Pascagoula River sand for the Pascagoula Beach HSDR as comparable traditional sand source values were not available. An additional 1.1 million CY of dredged material is placed in upland (DMMAs) or offshore (ODMDSs) placement areas.

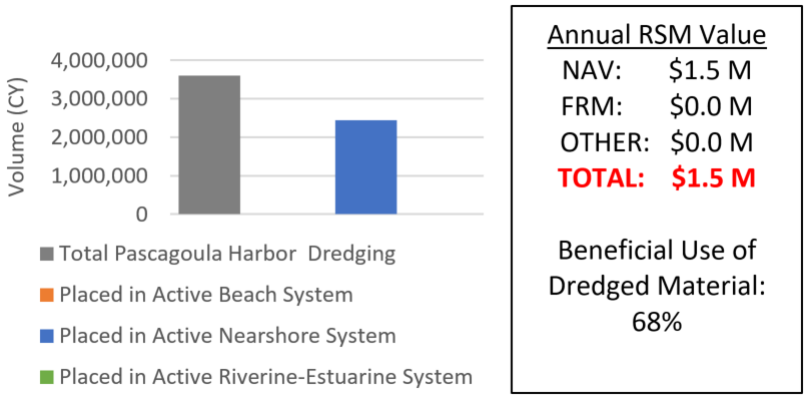


Figure 151. Average volume of sediment dredged from Pascagoula Harbor per dredge cycle (standard dredge cycle: 1–4 years). Total annual RSM value is $1.5 million. Value of sand placed in littoral zone not included.

Littoral zone placement is the cheapest placement options for much of the material dredged from Pascagoula Harbor and implemented RSM placement strategies help to keep sediment in the active system to minimize potential erosion and downdrift impacts.

Additional beneficial use activities at Pascagoula Harbor include use of three old dredged material placement sites as source material for the Mississippi Coastal Improvement Program Barrier Island Restoration Phase 1 (4.7 million CY) and Phase II (600,000 CY) and a 220 acre island marsh restoration project. Placement of 2.3 million CY at Mississippi's Beneficial Use Site at Round Island was supported by the National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit funds, Mississippi Departments of Marine Resources (MDMR) and Environmental Quality (MDEQ), and the Port of Pascagoula.

Figure 152. Map illustrating Pascagoula Harbor NAV and Pascagoula Beach HSDR project locations and adjacent areas.

Introduction

The Pascagoula Harbor NAV and Pascagoula Beach HSDR projects are located in Jackson County, MS approximately 100 miles east of New Orleans, LA and 50 miles west of Mobile, AL (Figure 152). The federal channel connects the Port of Pascagoula with the Gulf of Mexico and bisects Gulf Islands National Seashore (Horn Island, Sand Island, Petit Bois Island) via Horn Island Pass.

The Port is the largest seaport in Mississippi and transports approximately 37,000 tons of cargo annually that includes an estimated 33,000 tons of petroleum and petroleum products. The Port is also a major shipbuilding and ship repair hub. Placement options for dredge material include DMMAs, an ODMDS, TLP zones, beach placement, in water placement at Singing River Island (wetland creation project), and a nearshore-littoral zone placement area (Figure 153).

The Pascagoula Beach HSDR project protects infrastructure along Pascagoula Beach Boulevard including a seawall, roadbed, and residential areas. The project is approximately 7,700 feet in length and consists of a repaired seawall, replaced and extended drainage structures, geotextile tubes, beach-fill, and planted vegetation.

All Dredged Material Placement Strategies

A summary of dredged material placement strategies and total project costs is provided in Figure 153 and Table 68. Approximately 800,000 CY of sand/silt/mud is dredged from Pascagoula Bar every four years and is placed in the ODMDS at an annual cost $0.7 million (NAV 1) and 250,000 CY is dredged from Horn Island Pass and placed at littoral zone placement sites at an annual cost of $0.9 million (RSM 1). TLP zones are authorized to be filled up to -4 feet elevation.

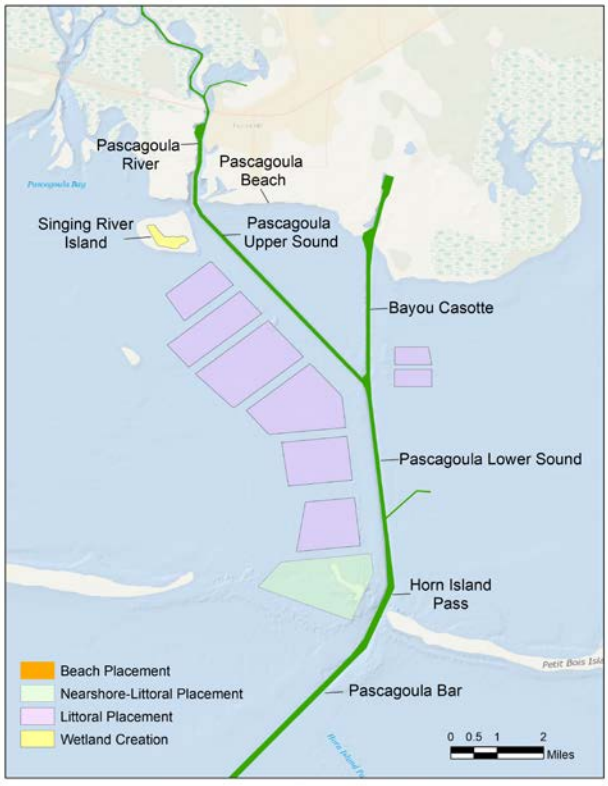


Figure 153. Map of Pascagoula Harbor material placement strategies. RSM strategies are indicated highlighted in Table 68.

Roughly 500,000 CY is dredged from Pascagoula Lower Sound every two years and is placed in littoral zone placement sites at an annual cost of $1.2 million (RSM 2). Relative to placement at the ODMDS (NAV 2), this RSM strategy provides a value of $0.2 million annually as placement at the ODMDS is $4/CY and TLP is $3/CY. Approximately 600,000 CY of material from Pascagoula Upper Sound is dredged every three years and placed at Singing River Island, a wetland creation project, and another 300,000 CY is dredged from the Upper Sound that is placed in littoral zone placement sites (RSM 3, 3a). The value for wetland creation is unquantified relative to traditional upland or offshore placement options and the value of wetland creation will be determined based on wetland mitigation

bank values upon completion of the project. Singing River Island is expected to be filled in approximately 10 years and will be planted with native wetland grasses.

Pascagoula River (100,000 CY) and portions of Bayou Casotte (250,000 CY) are dredged every three years and material is placed in DMMAs for $3/CY and an annual cost of $0.2 (NAV 4) and $0.5 (NAV 6) million, respectively. Some material from Pascagoula River is placed at Singing River at $4/CY. Bayou Casotte contains areas of high shoaling that require annual dredging. The cost of dredging 800,000 CY/year in these reaches is $4/CY for littoral zone placement and $7/CY to place at the ODMDS for a total value for littoral zone placement of $1.3 million annually relative to offshore placement (NAV 5, RSM 4).

The total value of implemented RSM strategies for Pascagoula Harbor is $1.5 million annually, which does not include the value of wetland creation at Singing River Island or calculated value for placement of material from Horn Island Pass or Pascagoula Upper Sound, relative to traditional placement options. Other beneficial use activities not captured in standard Navigation Operations and Maintenance at Pascagoula Harbor include use of three old dredged material placement sites as source material for the Mississippi Coastal Improvement Program Barrier Island Restoration Phase 1 (4.7 million CY) and Phase II (600,000 CY) and a 220-acre island marsh restoration project. Placement of 2.3 million CY at Mississippi's Beneficial Use Site at Round Island was supported by the NFWF Gulf Environmental Benefit funds, MDMR and MDEQ, and the Port of Pascagoula.

Table 68. Summary of Costs and Value of Dredge Material for Project at Pascagoula Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Pascagoula Bar to ODMDS	4	$3	800,000	$0.1	$0.3	$2.8	$0.7
RSM 1	Horn Island Pass to Littoral Zone	2	$6	250,000	$0.1	$0.1	$	$0.9
NAV 2	Pascagoula Lower Sound to ODMDS	2	$4	500,000	$0.2	$0.2	$2.4	$1.2
RSM 2	Pascagoula Lower Sound to Littoral Zone (DA 7-9)	2	$3	500,000	$0.2	$0.3	$2.0	$1.0
							Total RSM Strategy 2 Value:	**$0.2**
RSM 3	Pascagoula Upper Sound to Singing River Island	3	$3	600,000	$0.1	$0.2	$2.1	$0.7
	RSM 3 Other Benefit							**wetland value**
RSM 3a	Pascagoula Upper Sound to Littoral Zone (DA5-7)	2	$3	300,000	$0.1	$0.1	$1.1	$0.6
NAV 4	Pascagoula River to Singing River Island/Triple Barrell	3	$4	100,000	$0.1	$0.1	$0.6	$0.2
NAV 5	Bayou Casotte to ODMDS (alt)	1	$6	800,000	$0.2	$0.2	$5.2	$5.2
RSM 4	Bayou Casotte to Littoral Zone (DA 3-4)	1	$4	800,000	$0.2	$0.5	$3.9	$3.9
							Total RSM Strategy 4 Value:	**$1.3**
NAV 6	Bayou Casotte to Tenneco	3	$3	100,000	$0.1	$0.5	$1.4	$0.5
NAV 7	Bayou Casotte to ODMDS (alt)	3	$7	100,000	$0.1	$0.1	$2.0	$0.7
							Total RSM Strategies 1-5 Value:	**$1.3**

4.5.10 Biloxi Harbor Navigation Project

Summary

SAM is currently managing dredged material from the Biloxi Harbor NAV Project in an environmentally and economically beneficial manner. SAM beneficially uses approximately 1.3 million CY of dredged material from the East Access Channel, Lateral Channel, and West Approach Channel by placing it at the Beneficial Use Site at Deer Island and in TL) zones (Figure 154).

The cost of beneficial use placement versus upland placement are similar so economic value associated with environmentally responsible placement is limited. SAM beneficially uses approximately 98% of all dredged material from Biloxi Harbor. Beneficial placement of material at Deer Island is utilized to expand and restore the island and create tidal marsh habitat. The Deer Island Restoration Project, a federally funded project in the Mississippi Coastal Improvements Program, was recently selected as one of ten beneficial use pilot projects under the Water Resources Development Act (2016) Section 1122 Beneficial Use of Dredged Material. The pilot project was constructed in 2019 and was the first project in the 1122 program to be completed.

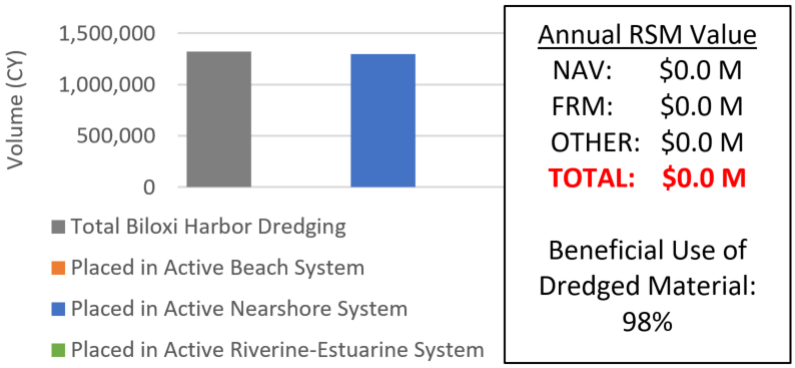


Figure 154. Average volume of sediment dredged from Biloxi Harbor per dredge cycle (standard dredge cycle: 1–3 years). Portions of the East Access Channel are dredged annually while all other cuts are dredged every three years.

Value relative to offshore or upland placement was not calculated as comparative costs were not available. Significant volume placed at Deer Island for beach and wetland restoration. Value currently not estimated.

Introduction

The Biloxi Harbor Navigation Project is located in Harrison County, MS and is managed by SAM in partnership with the City of Biloxi and the Biloxi Port Commission, the local sponsors (Figure 155). Biloxi was settled in 1699 and the local culture centers around its coastal and maritime heritage including recreational and commercial fishing and tourism.

Figure 155. Map of Biloxi Harbor and areas of interest related to the Navigation project.

Placement options for dredge material include a standard upland placement option as well as an authorized Beneficial Use Site at Deer Island and TLP areas associated with the Navigation project. Offshore placement sites are not authorized for the project.

All Dredged Material Placement Strategies

A summary of dredge material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 156 and Table 69. Dredge material from the East Access Channel, Lateral Channel, and West Approach Channel consists of silt and mud and dredge material from the Back Bay and Harrison County Industrial Seaway consists of sand and silt. The relative cost per CY is primarily a function of distance to the placement sites and additional equipment and effort required for placement at the individual sites.

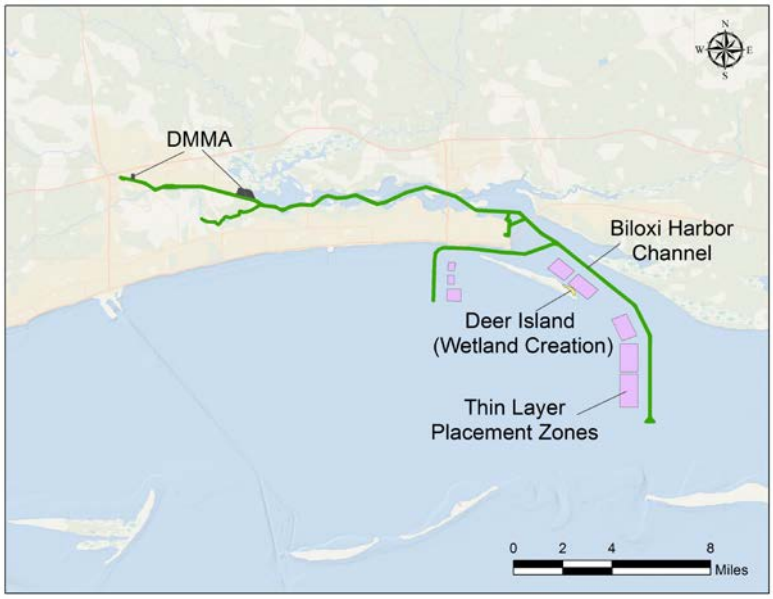


Figure 156. Map of Biloxi Harbor and RSM dredged material placement strategies. RSM strategies are highlighted in Table 69.

The project cost for annual placement of material from the East Access Channel to the TLP zones is approximately $3/CY for a total project cost of $2.9 million annually (RSM 1) while the remainder of the East Access Channel is dredged every three years and material is placed at the Beneficial Use Site at Deer Island at $5/CY for a total project cost of $1.9 million every three years or $0.6 million annually (RSM 1a). Placement of all material from the East Access Channel is used beneficially as TLP helps maintain sediment in the active system and placement at Deer Island also maintains sediment in the active system and helps to maintain coastal habitat at Deer Island.

SAM incorporates the same RSM placement strategies for the Lateral Channel and West Approach Channel by placing material beneficially at TLP areas and Deer Island (RSM 2, 2a). Cost for placement is approximately $4/CY and total project cost is $1.7 million every three years or $0.6 million annually.

Opportunities for Action

While all dredged material from the East Access Channel, Lateral Channel, and West Approach Channel are placed beneficially, opportunities for beneficial placement of dredged material from the Back Bay and Harrison County Industrial Seaway should be explored. Opportunities such as TLP are relatively inexpensive options for the project and may be a viable option.

Table 69. Summary of Costs and Value of Dredge Material for Project at Biloxi Harbor.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
RSM 1	East Access Channel to TLP Areas	1	$3	900,000	$0.1	$0.1	$2.9	$2.9
RSM 1a	East Access Channel to Beneficial Use Site (South Side of Deer Island)	3	$5	350,000	$0.03	$0.1	$1.9	$0.6
RSM 2	Lateral Channel/West Approach Channel to TLP Areas	3	$4	400,000	$0.05	$0.05	$1.7	$0.6
RSM 2a	Lateral Channel/West Approach Channel to Beneficial Use Site (South Side of Deer Island)	3	$3	100,000	$0.03	$0.1	$0.4	$0.1
NAV 3	Back Bay/Harrison County Industrial Seaway to Upland Placement	3	$8	20,000	$0.1	$0.05	$0.3	$0.1

4.5.11 Gulfport Harbor Navigation Project and Harrison County Beach and Hancock County Beach Hurricane Storm Damage Reduction Projects

Summary

SAM is currently managing dredged material from the Gulfport Harbor NAV Project in an environmentally and economically beneficial manner. SAM beneficially uses approximately 4.1 million CY of dredged material from the Bar Channel and Anchorage Basin/Sound Channel by placing the material in the littoral zone and in TLP areas (Figure 157). The cost of these RSM strategies is approximately equal to traditional strategies and is consistent with RSM principles of keeping sediment in the system. SAM beneficially uses approximately 51% of all dredged material from Gulfport Harbor.

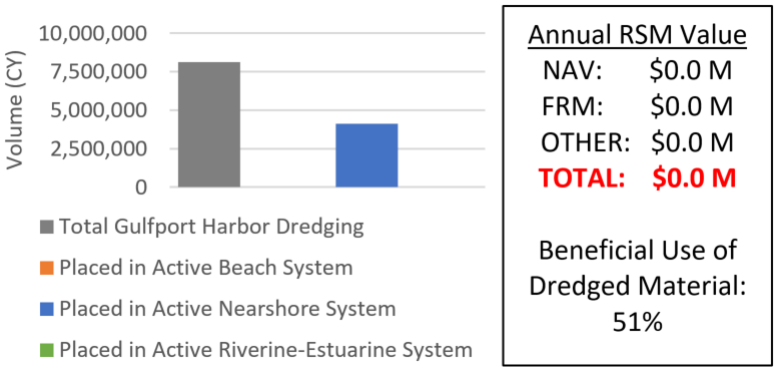


Figure 157. Average volume of sediment dredged from Gulfport Harbor per dredge cycle (standard dredge cycle: 2–3 years). Anchorage Basin and Sound Channel dredged every 2 years and Bar Channel and Gulf Channel dredged every 3 years.

The Harrison and Hancock County Beach HSDRs are maintained with offshore and upland sand, respectively. The projects receive sand every ten years and beneficial use sources of beach-quality material to maintain the projects are not available in the region. The HSDR projects are part of the Mississippi Coastal Improvements Program (MsCIP) and are the only MsCIP projects analyzed as part of the 2020 SAD RSM Optimization Update.

Introduction

The Gulfport Navigation Project is located in Harrison County, MS. The project is managed by SAM in partnership with the Mississippi State Port Authority at Gulfport, the local sponsor (Figure 158). Placement options for dredge material include an ODMDS as well as authorized littoral zone and TLP areas associated with the NAV project. Upland placement sites are not authorized for the project.

Figure 158. Map illustrating Gulfport Harbor, Harrison County, Hancock County, and areas adjacent to federal Navigation and HSDR projects.

The Hancock County Beach HSDR includes two segments separated by Buccaneer State Park that spans a total length of approximately 6 miles. The Harrison County Beach HSDR is a continuous project that spans approximately 25 miles from Bay St. Louis to the Deer Island/Biloxi Harbor area. The HSDR projects are part of the MsCIP.

All Dredged Material Placement Strategies

A summary of dredge material placement strategies, total project costs, and value provided by RSM strategies is provided in Figure 159 and Table 70. Dredge material from the Gulf Channel consists of sand and silt, dredge material from the Bar Channel consists of beach-quality sand, and dredge material from the Anchorage Basin and Sound Channel consists of silt and mud. The relative cost per CY is primarily a function of distance to the placement sites and additional equipment and effort required for placement at the individual sites.

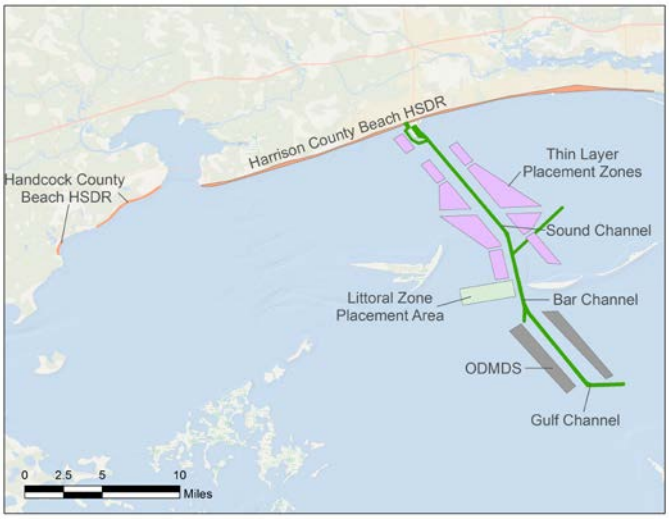


Figure 159. Map of Gulfport Harbor dredged material placement strategies and locations of Harrison and Hancock County Beach HSDRs. RSM strategies are indicated by green arrows that correspond with highlighted strategies and value identified in Table 70.

The project cost for placement of material from the Gulf Channel at the ODMDS is approximately $2/CY for a total project cost of $8.7 million every three years or $2.9 million annually (NAV 1). SAM places beach-quality sand from the Bar Channel in the littoral zone at a cost of $4/CY every three years for a total project cost of $1.1 million or $0.4 million annually (RSM 1). This placement strategy acts to provide sediment to downdrift beaches and provides storm damage reduction benefits.

Silt and mud dredged from the Anchorage Basin and Sound Channel is placed in designated TLP zones at a cost of $3/CY for a total project cost of $12.6 million every two years or $6.3 million annually (RSM 2). TLP is comparable to offshore placement. TLP is also consistent with RSM principles as the placement strategy keeps sediment in the active sediment system.

The HSDR project at Harrison County Beach receives approximately 890,000 CY of beach-quality material from an offshore borrow area every ten years for a total project cost of $8.9 million or $0.9 million annually (HSDR 1). The offshore borrow area is approximately 2,000 feet offshore throughout the length of the project. The HSDR project at Hancock County Beach requires approximately 180,000 CY of material from an upland source every ten years for a total project cost of $3.5 million or $0.4 million annually (HSDR 2). Sources of beach-quality material for each project are limited and sufficient quantities to maintain the projects from beneficial use sources are not available.

Opportunities for Action

While all dredged material from the Bar Channel, Anchorage Basin, and Sound Channel are placed beneficially, opportunities for beneficial placement of dredged material from the Gulf Channel should be explored. Developing economically feasible options is challenging considering the very low price of placement at the ODMDS ($2/CY). Opportunities such as TLP and island creation or enhancement could be possible options.

Table 70. Summary of Costs and Value of Dredge Material for Project at Gulfport Harbor and HSDR projects in Hancock and Harrison Counties.

Project Type	Source to Sink	Interval (Yr)	$ (CY)	Volume (CY)	USACE Labor ($ M)	Mobilization ($ M)	Total Project Cost ($ M)	Annualized Project Cost ($ M)
NAV 1	Gulf Channel to ODMDS	3	$2	4,000,000	$0.2	$0.5	$8.7	$2.9
NAV 2	Bar Channel to ODMDS	3	$2	125,000	$0.1	$0.5	$0.9	$0.2
RSM 2	Bar Channel to Littoral Zone	3	$4	125,000	$0.1	$0.5	$1.1	$0.3
NAV 3	Anchorage Basin/Sound Channel to ODMDS	2	$3	4,000,000	$0.4	$0.2	$12.6	$6.3
[A]RSM 3	Anchorage Basin/Sound Channel to TLP Areas	2	$3	4,000,000	$0.4	$0.2	$12.6	$6.3
						Total RSM Strategy 2 Value:		**$0.0**
HSDR 1	Offshore Borrow to Harrison County Beach HSDR	10	$8	890,000	$1.6	$0.2	$8.9	$0.9
HSDR 2	Upland Borrow to Hancock County Beach HSDR	10	$18	180,000	$0.2	$0.04	$3.5	$0.4

[A]No DMMA or ODMDS option available for Anchorage Basin/Sound Channel dredged material.

5.0 References

Berkowitz, J., C. Piercy, T. Welp, and C. VanZomeren. 2019. Thin Layer Placement: Technical Definition for U.S. Army Corps of Engineers Applications. U.S. Army Corps of Engineers Engineer Research and Development Center Technical Note 19-1.

Hershorin, A., T. Ledford, B. Nist, M. Schrader, C. McCoy, B. Martin, and L. Lillycrop. 2019. A review of RSM Implementation Strategies and Recommendations for Ecosystem Restoration in Tampa Bay, Florida. U.S. Army Corps of Engineers Engineer Research and Development Center Coastal Hydaulics Laboratory Technical Report 19-7.

National Ocean Economics Program. 2019. http://oceaneconomics.org/nonmarket/. Accessed on November 11, 2019.

Pendleton, L. 2009. The Economic and Market Value of Coasts and Estuaries: What's at Stake? Coastal Ocean Values Press, Washington, DC, USA.

Perillo, G., E. Wolanski, D. Cahoon, and C. Hopkinson. 2019. Coastal Wetlands 2nd Edition: An Integrated Ecosystem Approach, Perillo, G., E.Wolanski, D. Cahoon, and C. Hopkinson (Eds.), Elsevier, Cambridge, Massachusetts, USA.

Smith, M., D. de Groot, and G. Bergkamp. 2006. Pay: Establishing Payments for Watershed Services. International Union for Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland.

U.S. Army Corps of Engineers (USACE). 2019. United States Army Corps of Engineers Regional Sediment Management. http://rsm.usace.army.mil/. Accessed on November 01, 2019.

U.S. Army Corps of Engineers (USACE). 2007. Shore Protection Assessment – Beach Nourishment: How Beach Nourishment Projects Work. https://www.iwr.usace.army.mil/Portals/70/docs/projects/HowBeachNourishmentWorksPrimer.pdf. Accessed on January 20, 2020.